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The Circuit Court of Appeals reversed Judge Landis and said he placed himself above the law. The President reversed the Circuit Court of Appeals, and said there was absolutely no question of the guilt of the defendant. Now it is the Supreme Court's turn to say things about the President.

The statistics of the Committee on Car Efficiency regarding surplus freight cars indicate a greater increase during the past three months in the amount of traffic moving than actually has taken place. On April 29 the number of surplus cars reported was 413,605; on July 8 it was 303,560, a decrease of 110,045. But in order to ascertain the total number of idle cars those in the shops must be taken into account as well as those out of service and standing on side tracks. On April 29, when the surplusage reported was largest, the number of cars

in the shops was approximately 197,000; on July 8 the number had increased to approximately 232,000. The sum of the surplus cars and of the cars in the shops on April 29 is 609,605; the sum of the surplus cars and the shop cars on July 8 is 535,560; and the difference between these sums, 74,045, represents the increase in the number of cars in actual service between these dates. The total number of idle cars on July 8 was the smallest since April 1, when the surplus and shop cars aggregated 475,000. There has been a steady increase since the first week in February in the number of cars in the shops. A decrease or increase in the number of cars in service does not necessarily indicate a proportionate change in the volume or profitability of the traffic moving; for there always are accompanying fluctuations in empty car mileage, in the average lading of loaded cars and in the relative amounts of high grade and low grade traffic handled. Making allowance, however, for all factors of the problem, there can be no question that the freight traffic and earnings of the railroads of the country have for some weeks been showing a gradual, although not by any means a great, improvement. The large increases in the number of cars that are undergoing repairs show that the roads are anticipating still further and substantial increases in their business within the next few months. Whether their anticipations will be more or less than realized will depend primarily upon the results of the harvest, and also, though to a less degree, upon the trend and issue of the political campaign.

The opinions rendered by Commissioner Lane, of the Interstate Commerce Commission, in the case of Wilson Produce Co. et al v. Pennsylvania Railroad, and by the Wisconsin State Commission in the case of G. L. Dyer v. Chicago, Milwaukee & St. Paul, published in another part of this issue, both define the inter-relation of the Interstate Commerce Commission and state railroad commissions. There is nothing novel in the holding of the Interstate Commerce Commission that it has a right to overrule a state law which interferes with interstate business. It is too bad, from a legal point of view, that the Wisconsin Commission did not find the service given by the Chicago, Milwaukee & St. Paul to the little town of Fall River inadequate. In that case, if the commission had had the courage of its conviction, it would have ordered a fast interstate mail and express train to stop at Fall River. This would, of course, have been direct interference with interstate business, but might have been upheld by the courts, following the opinion of the Supreme Court in the case of Mississippi Railroad Commission v. Illinois Central. Here the Supreme Court says in part, "A state railroad commission has the right under a state statute, so far as railroads are concerned, to compel a company to stop its train * * * if the company does not furnish proper and adequate accommodation to a particular locality, and in such case the order may embrace a through interstate train actually running and compel it to stop at the locality named. In such case in the absence of Congressional legislation covering the subject, there is no illegal or improper interference with the interstate commerce rights." In the Supreme Court case referred to, the issue was not squarely met, because the court held that there was already adequate service. May not the words "In the absence of Congressional legislation covering the subject" suggest that there may be legislation in the future which will enhance the powers of the Interstate Commerce Commission at the expense of the state railroad commissions?

THE FRUITS OF DRASTIC RAILROAD REGULATION IN TEXAS.

Texas was a pioneer in the drastic regulation of railroads. This fact imparts significance to the statement by R. A. Thompson, Chief Engineer of the Railroad Commission of Texas, published in the *Railroad Age Gazette* of July 24, showing that railroad construction in that state is at a dead stand. The making of permanent improvements likewise has ceased. Mr.

Thompson contends that there is here no relation of cause and effect, and attributes the existing situation to "slanders that have been widely circulated regarding the state's corporation policy." The assertion that the cessation of railroad development in Texas is due to libels upon the state's corporation policy will not stand investigation. Much of the greater part of the mileage built and seriously projected in the state for some years has been built and projected by systems already having lines there. Their owners and managers are not to be influenced by alleged libels upon the state's policy. They know what that policy is. They have experienced its effects. They have stopped construction and improvements because the state legislature and railroad commission have made construction and improvements unprofitable, and even impossible. States that are disposed to follow the lead of Texas may study that state's railroad policy with profit just now if they will be warned by its results.

Texas established in 1890 its "railroad commission with teeth." The Commission has kept its teeth sharp and busy ever since. In 1893 the legislature passed the "stock and bond law," providing that thereafter no bonds or other evidence of indebtedness should be increased or issued by any railroad in the state over or above the reasonable value of its property, "provided that in case of emergency, on conclusive proof shown by the railroad company to the railroad commission that public interest or the preservation of the property demand it, the said Commission may permit said bonds, together with the stock in the aggregate, to be executed to an amount not more than 50 per cent. over the value of said property." This appears superficially to be a fair and reasonable statute; but it has proved a millstone on the neck of railroad enterprise. It has made it hard or impossible to raise money to build new lines, because the securities of projected roads in an undeveloped country, like the securities of other projected industries, almost always must be sold far below par. In connection with the general policy of the legislature and the Commission, the law has placed great obstacles in the way of extensions and permanent improvements by even the strongest existing lines.

The sworn reports of the Texas roads for the year ending June 30, 1907, showed that the total cost of construction and equipment of the mileage in the state had been \$444,839,449.76. The State Tax Board in the same year valued the property of the railroads, tangible and intangible, at \$419,381,404. Their capitalization is approximately \$400,000,000. Their bonded indebtedness alone on June 30, 1907, amounted to \$272,704,477. But the State Railroad Commission in 1907, for purposes of regulation of rates, placed a valuation upon their tangible properties—physical valuation alone being, in the Commission's opinion, entitled to consideration in fixing rates—of only \$200,222,306, or but 45 per cent. of the valuation of the State Tax Board. The valuation of the Railroad Commission being \$72,000,000 less than the aggregate of bonds outstanding, most of the roads in Texas could not, under the stock and bond law, issue securities to raise money for permanent improvements or extensions. Improvements and extensions must therefore be made chiefly from earnings.

But even before the panic last October it was impracticable for most of the Texas roads to make extensive additions and improvements out of earnings, and at the same time pay any dividends; and since then it constantly has grown less possible. The Texas commission has boasted that it has been more skilful than the commissions of other states in reducing the earnings of railroads—that by making no sweeping, but innumerable small reductions it has succeeded in getting rates to a very low basis without giving the roads a chance to have its orders declared confiscatory. The railroad officers who have had to deal with the Commission would be the last to deny the cunning of its methods. Let us see what have been the results. In the fiscal year ended June 30, 1907, the most prosperous year in their history, the net income from operation of the Texas lines was but 5.49 per cent. of the valuation placed upon them

by the State Tax Board. In the fiscal year 1906 it was but 4.98 per cent. of the Tax Board's valuation in that year. Nevertheless, the Commission late in 1907 issued orders requiring 47 roads to buy new equipment, and early in 1908 it issued further orders requiring certain railroads to make very costly improvements in their roadway and stations. Some of these orders have been withdrawn; none has been enforced *in toto*; even the Railroad Commission of Texas cannot force railroads to do what is physically impossible. The baneful effects of an unfair and vicious policy of railroad regulation do not become visible in periods of heavy traffic and general prosperity; they become painfully manifest when business depression sets in and traffic slumps. The Texas Commission reduced the earnings of the railroads in prosperous times to what it considered "fair." Operating expenses meantime were being rapidly advanced by heavy increases in wages and prices of materials, and by state laws and orders of the Commission, requiring the installation and maintenance of interlockers, limiting the hours of labor of some employees to 14 and of others to 8, fixing the number of employees in train crews, limiting the time that passenger trains might wait for connections, requiring electric headlights, etc. The following table, comparing the net income or deficit of 23 roads in the 9 months ended March 31, 1907, and the 9 months ended March 31, 1908, shows to what straits the state's reckless policy in prosperous times reduced these roads in unprosperous times:

	Net Income,		Deficit	
	9 months ending—	9 months ending—	9 months ending—	9 months ending—
	Mar. 31, '08.	Mar. 31, '07.	Mar. 31, '08.	Mar. 31, '07.
C. R. I. & G.	\$184,379.48	\$142,188.69		
F. W. & D. C.	184,522.10	276,402.52		
F. W. & R. G.		164,174.08	\$136,735.21	
G. H. & S. A.		1,084,696.34	275,191.36	
G. C. & S. F.		1,204,722.34	816,408.17	
H. & T. C.	475,476.88	1,312,629.84		
H. E. & W. T.	51,848.53	269,159.65		
I. & G. N.		523,964.14	1,605,408.63	
K. C. M. & O.		45,110.00	14,025.24	
M. K. & T. of T.		639,923.09	574,679.21	
P. & G. N.	44,682.34	25,924.22		
St. L., B. & M.	20,952.52	132,976.81		
St. L. S. P. & T.			193,007.59	\$169,298.91
St. L. S. W. of T.			620,675.24	596,924.16
S. A. & A. P.		681,224.90	72,625.78	
Texas & Gulf	4,981.28	42,167.75		
T. & B. V.			967,107.81	157,201.17
T. & N. O.	143,796.04	484,354.50		
T. & P.		694,159.90	1,214,871.21	
Texas Central	186,900.27	374,062.27		
Texas Mexican			128,767.02	89,374.46
Texas Midland			136,833.11	72,492.40
W. M. W. & N. W.	38,589.31	46,446.46		
Totals	\$1,336,128.75	\$8,144,287.50	\$6,756,335.75	\$1,085,291.10
Net inc. or def.		1,085,291.10	1,336,128.75	
		\$7,058,996.40	\$5,420,206.83	

*Entire line.

No. roads showing net income in 1906-7.....18
 Net income, 23 companies considered as a whole, 1906-7.....\$7,058,996.40
 No. roads showing deficit in 1907-8.....13
 Net deficit, 23 companies considered as a whole, 1907-8.....\$5,420,206.83
 Difference against the nine months of 1907-8.....\$12,479,203.23

These figures, which were prepared by a statistician for the railroads, show why the 23 railroads mentioned are not making extensions and improvements from earnings. A statements issued by the Commission regarding the receipts and expenses of all the railroads in the state for the 10 months ended April 30 (*Railroad Age Gazette*, July 10, 1908, page 496), while not seemingly so unfavorable, is quite bad enough.

The Commission, taking as a basis its own valuation of the physical properties, has at times sought to show that the percentage of profit of the roads in the state in good times was large, rising as high even as 12 per cent. annually. But railroad owners, like other investors, insist upon being allowed to estimate their profits for themselves. The owners of the railroads in Texas refuse to bow in this matter to the superior wisdom of the Commission. They believe that their properties are reasonably worth more than the \$400,000,000, for which they are capitalized. The valuation of \$419,000,000 upon which the state taxes the properties tends to confirm them in this belief; and, despite the Commission's indignant and virtuous protestations to the contrary, the owners of Texas railroads will persevere in believing that they are being wronged, not to say robbed, by a policy that scales down the

earnings of their properties, regardless of their cost, of their lawful capitalization and of the valuation upon which the state of Texas taxes them. So long as it is felt by the present owners of the railroads in Texas that they are being unfairly dealt with, they are not very apt to increase greatly their investments there, nor are other persons very apt to begin investing in railroads there on a large scale.

The situation would look well-nigh hopeless for the railroads and for future railroad development in Texas, but for the unmistakable change of public sentiment that is taking place in the state. There are 55 counties in Texas without a railroad. Many other counties have utterly inadequate transportation facilities. The people of these parts of the state are clamoring for more railroads and not getting them. They are beginning, therefore, to see that the railroad policy of the state has been, from the standpoint of the public welfare, exceedingly stupid. They are beginning to realize that to make confiscation of corporate property easy is not the best way to attract outside capital or to get capital already within the state invested in corporations. They are beginning to perceive that, in order to stimulate railroad development, it is necessary to let railroads earn, not merely what a political railroad commission may regard as a fair profit, but what the owners of the railroads consider a fair profit. The awakening public intelligence and public conscience is reflected in denunciations of the Commission and of Governor Campbell by citizens and newspapers all over the state, in dissensions among the members of the Commission, and in the recent comparative inactivity of that heretofore perniciously active body. A mere temporary veering of public sentiment will not, however, hearten the managements of the railroads in Texas. The revival of railroad development on a large scale in the state must be preceded by the repeal of many of its restrictive and burdensome laws regulating railroads. It must also be preceded by the advent of a railroad commission whose members will not merely make chicaning professions of fairness, but who will act in a spirit of true fairness as arbiters between the shippers and travelers of the state and the railroads of the state, recognizing the fact that when either party to the arbitrament is given a wrongful advantage over the other the public will in the long run be the principal sufferer.

THE STANDARD OIL CASE.

Many severe criticisms have been passed upon the rulings made, the opinion rendered and the judgment entered by Judge Kenesaw M. Landis in the famous case in which the Standard Oil Company of Indiana was sentenced to pay a fine of \$29,240,000 for the alleged acceptance of rebates from the Chicago & Alton Railway; but no lawyer or layman has ever excoriated him more trenchantly than the United States Circuit Court of Appeals did in its opinion reversing his judgment. Judge Landis' course during the trial in the federal district court was denounced in these columns at the time as a novelty in Anglo-Saxon jurisprudence (*The Railway Age*, July 12, 1907, p. 37); and the Circuit Court of Appeals now expresses the same view. The opinion of the Circuit Court of Appeals is perhaps chiefly important, in the present period of clamor against large business concerns, because of its emphatic vindication of the right of corporations, no matter how large they may be, no matter how widespread and deep-rooted the popular prejudice or how strident the popular outcry against them may be, to be brought into court and penalized only when some offense is alleged against them specifically, and to be clothed, when there, with the same presumption of innocence, and to be tried according to the same rules of procedure, that protect the poorest and meanest culprit that was ever dragged trembling before an Anglo-Saxon bar of justice.

The Circuit Court of Appeals made three points that are of much interest and importance to shippers and railroads throughout the country. These relate to the responsibility of shippers under the Interstate Commerce act for knowledge

of the legal rates; to the basis to be used in determining the number of offenses that may have been committed; and to the size of the fine that may be imposed for violations of the law. Judge Landis held—and the Interstate Commerce Commission has ruled similarly—that the shipper is charged with knowledge of the legal rate, and may be punished for using a less than the legal rate, even if the railroad has quoted the lower rate to him in writing. The Circuit Court of Appeals says:

"In this interpretation . . . we cannot concur. . . . To the carrier the doctrine that ignorance of the fact is no defense is perhaps applicable. . . . But is the ordinary shipper bound at his peril . . . to cipher out, before he can safely put anything that he has into commerce, all the confusing papers and figures that generally make up the tariff sheet? Plainly not, it seems to us. . . . The law is the same for all shippers . . . viz., that before conviction there must be proof of all the facts upon which the shipper's offense is predicated."

The conclusion was that Judge Landis should have submitted to the jury all evidence tending to show whether or not the Standard Oil Company knew whether the rate that it used was legal—that it cannot be assumed that the shipper acts with criminal intent when he uses a less than the legal rate, but that his criminal intent—a necessary element of a criminal act—must be proved like any other fact. This ruling, if upheld by the Supreme Court of the United States, will remove all ground for the complaint that has been made by shippers that they may be punished for using in good faith rates incorrectly quoted by the railroads. The law, as interpreted by Judge Landis and the Commission, was undoubtedly adapted to work hardships upon shippers in some instances. While the interpretation of the Court of Appeals tends to remedy this defect, it also may make rebating harder to detect and punish. There is always present the danger that, acting collusively, the railroad traffic manager may quote and the shipper use a rate less than the legal one. In many instances it would be impossible to establish that the shipper knew that the rate he used was illegal unless his railroad co-partner in crime turned "state's evidence," and the railroad would have strong reasons for not doing this. By holding that the guilty knowledge of the railroad, may be assumed, while the guilty knowledge of the shipper must be proved, the court establishes one rule for the railroad and another for the shipper, and puts the railroad in a position where it will be harder to resist the solicitation of rebates than it would have been under the rulings of Judge Landis and the Commission.

Judge Landis held that the number of offenses was 1,462, being the number of carloads shipped at the alleged illegal rates. The Court of Appeals says: "The gist of the offense is the acceptance of the concessions." The law is not violated by a mere agreement to give and receive a rebate, but by the actual giving and receiving. There were 36 settlements between the Alton and the Standard Oil Company of Indiana on the basis of the alleged illegal rates, and, therefore, holds the Court of Appeals, the maximum number of violations, if any, was 36, not 1,462. This ruling might suggest to shippers and railroads that might be disposed to violate the law the expediency of making shipments on illegal rates as large as possible, and settlements as few as possible. However, we believe that the view expressed by the Court of Appeals is more in accord with the intent of the law than that taken by Judge Landis; and the fine and imprisonment penalties fixed by the Hepburn act for rebating are so heavy, and the popular demand for the rigorous enforcement of the act so insistent, that the ruling is not likely to increase the amount of rebating, of which there is less now than there ever was before in the history of American railroads.

The energetic condemnation by the Court of Appeals of Judge Landis' abuse of his judicial discretion in imposing the maximum penalty will be approved by every person whose sense of fairplay has not been dulled by the clamor against corporations, and who has the discernment to recognize the dangerous tendency of the opinion delivered and the judgment

entered in the district court. The law made the Standard Oil Company of Indiana and the Standard Oil Company of New Jersey two distinct corporations. But because the latter corporation was a stockholder in the former, Judge Landis, who is on the bench to construe and apply the law exactly as he finds it, chose to disregard it entirely, and to impose penalties upon the Standard Oil Company of Indiana the collection of which he knew would bankrupt that company many times over, but which, as he thought, the Standard Oil Company of New Jersey could afford to pay, and ought to be made to pay, owing to its alleged previous bad record. He had no more legal right, as the opinion of the Circuit Court of Appeals plainly implies, to take judicial cognizance of the wealth or alleged turpitude of the Standard Oil Company of New Jersey, in passing sentence upon the Standard Oil Company of Indiana, a separate legal person, than he would have had to take judicial cognizance of the poverty and virtue of some poor widow who may possibly have owned a single share of stock in the Standard Oil Company of Indiana.

If Judge Landis could in this case lawfully—as he did unlawfully—take judicial cognizance of facts, alleged or actual, which were entirely extraneous to the proceeding before him, and if he could in the exercise of his judicial discretion impose penalties so gigantic that their collection would involve the infliction upon the Standard Oil Company of Indiana of what would have amounted to capital punishment for an offense, which until twenty-one years ago was not treated by the laws of the United States as a crime at all, or even as a misdemeanor—then no industrial corporation, no railroad corporation, no person who ships goods or has capital invested in industrial or railroad corporations could have felt any assurance that the law, while severely punishing, as it ought, the great industrial crime of rebating, would still afford protection against the absolute confiscation of the property directly or indirectly involved. The original Interstate Commerce Act, the Elkins Act—the validity of which seems successfully to have withstood the scrutiny of the Court of Appeals—and the Hepburn Act were designed, not to confiscate the property of offending shippers or railroads, but to stop their offending; and the decision of the Circuit Court of Appeals indicates that the higher federal courts, at least, will insist that the wrongs aimed at must be so punished that greater wrongs will not, under the guise of enforcement of the law, at the same time be inflicted.

NEW PUBLICATIONS.

*Cours d'économie politique professé à l'Ecole nationale des Ponts et Chaussées par C. Colson, Conseiller d'Etat. Livre 6me: les travaux publics et les transports. (See also the *Railroad Gazette*, May 29, 1908, p. 721.)

This is the final volume of the work on political economy by M. Colson, the publication of which was begun several years ago. The five books preceding (three volumes) cover the general subject and finance, and are specially interesting to those engaged in transportation chiefly because the author's career has brought him intimately into contact with the business of carriers and led him to illustrate his discussions largely from it. This final volume on "Public Works and Transportation" is the crown of the work, and doubtless the most complete treatise on the special economics of transportation that has ever been published.

Some of those who read the *Railroad Gazette* so long ago as 1891 may remember the translation of a considerable passage from an earlier work of M. Colson, entitled "Transportation and Rates," and comments thereon (pp. 612 and 616, Sept. 4, 1891).

The author had long been a member of the board which receives all proposals for changes in rates on the French railroads and hears arguments for or against such changes by the interested parties, and reports its findings to the Minister of Public Works, without whose "homologation" no new rate and no change in rates can be made. This seems an ideal position

in which to learn the principles governing rates, and Mr. Colson has made full use of his opportunity.

It may seem surprising that so extensive a work on political economy should be prepared for the students in an engineering school. Strictly technical subjects tend to drive almost everything else out of our engineering courses, and yet the students of the great French "School of Bridges and Highways" are offered a course in economics covering about 2,400 large octavo pages. But in France they seem to aim to train their students to be men as well as engineers. Possibly this may have something to do with the esteem in which the profession is held in that country, where almost every cabinet has among its members one or more engineers, and where more than once an engineer has been prime minister.

The public works with which this book is concerned have as their essential object to satisfy certain economic needs experienced by individuals, and which private initiative cannot provide for, or would not provide for well for two essential reasons, both resulting from the impossibility of organizing the services necessary without creating a continuous system of tracks, electric conductors or pipes covering contiguous territory of considerable extent, as for roads, canals and railroads for transportation, for gas, water and electric currents, and for drainage work, while from the extent of contiguous territory required for such works individual enterprise cannot execute and administer them without a delegation of public authority.

Again the extent of such works is such that usually a given territory can be served, or served economically, only by a single system, which makes competition impossible; so that when the public authority confers on individuals the powers necessary to construct such works, it also confers a monopoly, which may result in inadequate services to those using them and inordinate profits to the owners of the works, unless the public authority exercises supervision and control. They are public services, but public services whose essential object is to benefit private interests. This gives them a peculiar economic and juridical character, depending in part on public and in part on private law, and requires their special treatment in political economy.

The leading part which commercial corporations have had in the construction and conduct of such public works may seem at first sight to negative the statement that they are instruments for rendering public services; but whether this character is formally recognized by law, as in France, or is difficult to distinguish in the empirical regulations established from time to time as their need is felt, as in England and the United States, this character is always the same; private enterprise intervenes in public works only by a formal delegation of public authority.

The author himself in an introductory chapter summarizes his program, the great bulk of the work being devoted to transportation routes, and chiefly to railroads. He begins by endeavoring to determine theoretically the price of transportation, what influence the imposition of tolls (on railroads the part of the charge which is attributed to the use of the road), may exercise on the services rendered, and in what measure it is just to make those pay for the services who profit by them, or, on the contrary, make them a charge the whole community (as on public highway). Then he considers the general situation of transportation routes in France and some other countries, especially as to their traffic, expenses and receipts, as a basis of fact, for the study of the practical solution of the various questions arising besides the theoretic considerations.

Then he attacks the primary question of all, how to estimate the utility of a projected enterprise, the elements which compose the cost of transportation, the reduction of which is the sole direct advantage to be expected from the construction or improvement of transportation routes, and also what account is to be taken of the indirect advantages resulting therefrom. Then he considers the methods by which the largest possible

receipts are to be obtained from the charges imposed, without arresting the development of traffic, and how rates are established; the consequences of multiplying agencies for supplying the same needs, the momentary competition resulting therefrom, and the mutual agreements which sooner or later put an end to such competition.

He then investigates the degree to which private enterprise may profitably be employed in providing public services of this kind, the advantages and disadvantages of operation by the state or by companies, the object and nature of the supervision which, in all cases, public authority should reserve to itself; the different systems tried to realize this association of public authority and private enterprise, from the financial point of view, by subsidies, guarantees of interest and sharing in profits.

As we said in reviewing the earlier work by M. Colson, one who has been forced to study the economic transportation questions arising in this country during the last forty years, is constantly impressed by the identity of many of his own conclusions with those here recorded, deduced from an experience under a widely different governmental régime. To some of these conclusions we hope to revert hereafter, meanwhile commending the work to the attention of all who study questions of transportation and rates, to traffic men and public authorities who have to deal with such questions. This final volume of 520 pages will be perfectly intelligible to them all, however little theoretically versed in economics. To many of the higher officers, the questions discussed therein come home to their business and bosoms with a vengeance in these days.

Letters to the Editor.

RAILROAD CURIOSITIES.

New York, July 18, 1908.

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

Noting reference to old ticket used by Norwich & Worcester Railroad, I am reminded that you might have made a reference, also, to the fact that a treasurer of this company (a gentleman named Perkins) continued in service up to the time of his death at the age of 100 years and some odd months, after a continuous service as treasurer for more than 50 years. Isn't this record unique? Was there ever any other railroad treasurer "in the harness" at 100?

Another oddity that you might care to make an item of some time is the service on the old main line of the Hudson River Railroad from Thirtieth street station. These are probably the only steam trains in service in the country that pick up more passengers en route, that is to say, while under way, than they start off with. The train leaves Thirtieth street with some 12 to 18 passengers, but others jump on as it moves up Eleventh avenue and by the time it gets to Fifty-ninth street about every seat is taken. All this without making any stop. Isn't this somewhat of a novelty?

F. W. SAWARD.

FREIGHT RATES AND THE COMMISSION.

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

How much sincerity and intelligence there is in the "arguments" pro and con which are published concerning the proposed general increase in freight rates is a hard question to settle, but if the alleged spokesmen of the alleged fearful merchants really believe, as they say, that the railroads are making as much money as anybody else, and that raising prices in dull times is utterly indefensible, I should like to call their attention to the illustration that is afforded by the cases of numerous trolley roads. Advances in fares have been proposed on electric roads all over the country, and have been carried out in some cases; but no well-posted business man

impugns the sincerity or the judgment of the managers who make the changes. In spite of a good deal of watering of stock and other wasteful measures, it is plain that many trolley roads have undertaken to give the public too much ride for 5 cents, and at last the owners of the roads have had to admit the fact. The public can see that the situation is honestly set forth because the cars, the track and the service are allowed to deteriorate, while yet the managers obviously are trying their best to keep the establishment running and to satisfy the public, and they are paying no dividends. When the announcement of a raise in fare is published nobody objects—except on the one ground on which all of us object to the price of everything, that we need the money and do not care anything about the other party's needs. Now, the fact that the public has been treated too liberally is just as certain in the case of thousands of freight rates—and passenger rates, too—as it is in the case of the trolley fares. The trouble is to make the public believe it. What a pity that there are not a few great railroad managers with such solid reputations for judicial mindedness that their statements on this subject would be accepted by the public without question! It is futile, however, to sigh for reputations in this line, for it is difficult to find a railroad president who does any judicial *thinking*, so far as we can judge by their published utterances. A reputation cannot be built on air. When the late A. J. Cassatt was so bold as to say that he thought that, possibly, the rate-making power might be given to a government board without causing the railroad heavens to fall, every other railroad president held his breath; it was so different from anything ever said by a conservative president before! What a pity that there is not a man on the Interstate Commerce Commission who will speak out as strongly for the railroad side as certain of the commissioners do for the shippers' side. Here, again, I am suggesting the unheard of, the impossible; but surely a railroad voice as strong as James J. Hill's would not be any more out of place, on the Commission, than the anti-railroad voices exercised by some of the commissioners during the past few years. The Commission is not without judicial-minded men; but they do not talk out very vigorously.

It is not unheard of to raise prices in hard times. A merchant cannot do it, because other merchants, richer than he, will take his business and drive him to the wall. But suppose the case of a railroad that becomes insolvent, while yet its continued operation is a necessity to the towns through which it runs. What does the public do? It puts the property in the hands of a court and the court spends the money necessary to give the service—perhaps not an adequate service, but a respectable minimum, at least—which the public needs. This is substantially the same as raising prices; for, the past adjustment of rates and of expenses having broken down, the railroad must now get more for its service or else the public, if it is to continue to have its railroad, must support it in part by taxation. Our big railroads are, indeed, still out of the receivers' hands; but in so far as they have been carrying freight or passengers at less than cost plus a minimum profit, they have been tending surely toward a receivership. The immediate question is, How can those railroads which, by reason of conditions like this, actually deserve, at the hands of the public, a more liberal treatment, convince the public that the claim is well founded?

The Interstate Commerce Commission, instead of doing what it can to settle these grave questions which vitally affect the conduct of railroad traffic throughout the country, is engaged in deciding such momentous matters as the proper door by which a citizen of Hornell, or Monon, or Ogden shall enter a railroad restaurant, and whether or not, after entering, he may lawfully eat salt on his hash! This epoch-making decision which, I presume, you will duly report in your news columns, has elicited from a New York railroad officer the following comment:

More or less amusement was created in railroad circles over the decision of the commission that restaurants operated by a railroad cannot

serve the general public unless all the supplies have paid the regular freight rate.

This is a very important ruling and really justifies the campaign of the people to make the railroads stop discriminating, although it will result in some trouble in order to ascertain just who are customers of the railroad. The commission, in its wisdom, has left much unsaid. At some railroad restaurants, the eggs, the butter, the milk, and the bread are purchased in the local market, and I am afraid some citizen, acting under his constitutional rights, can demand that he be served with them over our lunch counters, although I must say, if the waiter has come to his place of employment on a pass, as an employee, he would be violating the spirit of the decision in serving a man who had not bought a railroad ticket. There are other complications. Let us take the bill of fare and eliminate the interstate waiter. We have ham and eggs, roast beef, potatoes, lettuce salad, bread and milk and ice cream. The eggs and milk came in from the country. You, as a customer, can have that. The ham and beef came from Chicago, so we bar you there. The ice cream was made in the restaurant from country milk and eggs, but the salt and the ice to freeze it and the freezer came over the railroad as free supplies, so you cannot have your ice cream frozen. Of course, you can get a few things to eat, but the fellow alongside of you, who has paid 20 cents for a ticket to the next station, gets it all. It seems to me that the commissioners are deciding in favor of the plutocrat who has money to buy a railroad ticket; and they may hear from Oyster Bay.

S. G. B.

LUBRICATION OF DRIVING WHEEL FLANGES.

Santa Fe, Prescott & Phoenix Railroad. }
Prescott, Ariz., July 3, 1908. }

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

In your issue of June 26, page 396, under title of "Lubrication of Driving Wheel Flanges," there are some errors which have already, as shown by letters of inquiry, developed seriously mistaken ideas of flange lubrication.

The photograph in the article in question shows a lubricator never seen or used on the locomotives of the Santa Fe, Prescott & Phoenix. The first paragraph describes conditions precisely as they exist on this railroad in connection with the use of the Elliott flange lubricator. The second paragraph also correctly describes conditions that obtain on this line.

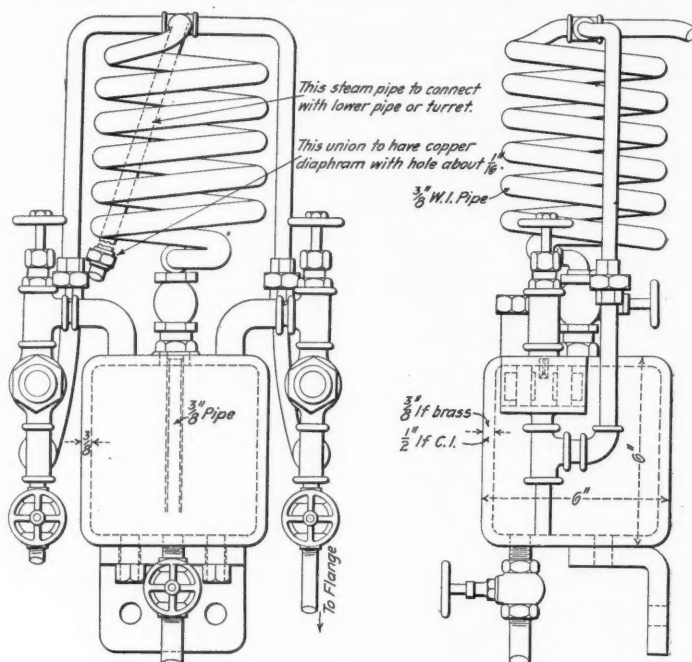
The third and last paragraph evidently describes the lubricator which you illustrate, but it can have no connection whatever with the things written in the first two paragraphs as connected with our line.

Some results obtained with the Elliott flange lubricator were given in the *Railway Age*, May 4, 1906.

In order that the conflict of ideas may be better explained, I enclose blueprints of the Elliott flange lubricator, which is the one used on the Santa Fe, Prescott & Phoenix, with the results which fit the description in your first two paragraphs. The comparison of these drawings with the photograph mentioned will easily show the difference in design. The Elliott flange lubricator was designed and patented by H. W. Elliott, our Road Foreman of Engines. We have used this lubricator for three years. It is now applied to all of our company's locomotives. It has also been applied to a great number of locomotives on the Santa Fe Coast Lines, and I understand that all of them will soon be so equipped. The Coast Lines officials write Mr. Elliott that the results are quite satisfactory.

The Elliott flange lubricator consists of a steam down-feed bull's-eye lubricator, placed in the engineman's cab, and works

as does the cylinder lubricator. It is operated at low pressure and temperature, just enough steam being used to feed the oil and carry through the pipes and nozzle, which forms a strong jet or spray against the flange. It is used on only one pair of wheels, preferably the front driving wheels, as it has been demonstrated that this furnishes sufficient lubricant for all of the wheels and the inner side of the head of the rail as well. This device is operated by, and under perfect control of, the engineman. It has a positive feed of the heaviest California crude oil under all climatic conditions.



Elliott Flange Lubricator.

No renewals or repairs have so far been found necessary, nor are any adjustments required after being first properly installed.

As I said before, all of our locomotives are equipped with this lubricator, and we have observed astonishing results from its use. The records show that sharp driving wheel flanges have been entirely obviated, and all other flange wear has been reduced 50 per cent. The saving in the wear of the rail is astounding, but we have no comparisons by which the value of such saving can be reduced to dollars and cents; it certainly would run into large figures. It has been found unnecessary to turn driving wheel tires except for tread wear. Locomotives with the lubricator take curves very much more easily and our roadmasters report that the track is therefore kept in better alignment and gage, and the result is much less danger of flanges climbing the rail on sharp curves. The flange friction in long freight trains seems to be appreciably reduced.

W. A. DRAKE,

Vice-Pres. and Gen'l Mgr., Santa Fe, Prescott & Phoenix R. R.

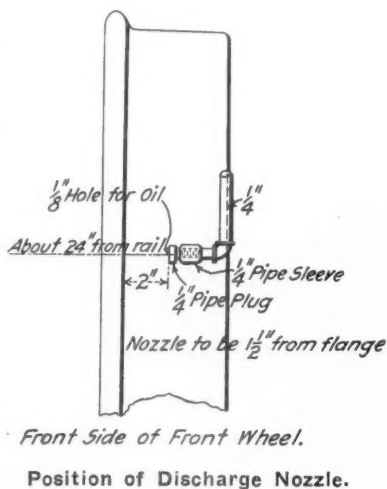
GETTING RESULTS OUT OF A SHOP.

July 27, 1908.

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

I have been reading the different articles on piece work, premium work, bonus work, etc., in railroad shops that have appeared in your columns lately, beginning with your issue of May 8, and I am somewhat amused at the different arguments brought out as to the relative merits of the different systems.

I served my time as a machinist in a railroad shop, and worked for years at railroad repair work, both on a day and an output basis. I have been an inspector, a gang foreman, a shop foreman and a general foreman both on day-work railroads and roads that pay by output, and yet I fail to see where there are any serious grounds for dispute or argument as to



Position of Discharge Nozzle.

the relative merits of the different systems of payment, particularly when the subject to be considered is railroad repair work.

There are but two methods on railroads whereby workmen receive compensation for labor performed; one is, according to the time put in—or day rate as it is commonly called—and the other is by the amount or output. It goes without saying that paying by output is the best, fairest, most equitable and every way the most satisfactory, both for employer and employee. There has been once in a while a little trouble and on one or two occasions a serious strike over the introduction of the latter method of payment, but in almost every case the real trouble was not objection to the method as a whole, but to the manner of its introduction. It was not the name of the system; it mattered not what the method was called. "A rose by any other name would smell as sweet." A few agitators can cause trouble in any shop at any time and they seize on a payment-by-output proposition as being as good a pretext as any other to stir up something.

The average workman always wants to be paid according to the amount he does. It comes natural in most cases to be progressive. Did you ever see the look an able-bodied workman gives a street car conductor if he comes to a full stop for him? He wants to get on or off while the car is in motion. Did you ever see an empty corner lot that workmen passed on their way to work that they did not cut across? The general tendency of the majority of workmen is toward short cuts. They want, of course, to receive compensation in comparison with the amount done. They don't care what name is given to the system. It is of no real consequence to them whether it is called "bonus" or "piece work" or "premium" or "individual effort" or "differential" or any other term. The only real difference in any of the systems is in the dream of some enthusiast who has developed some special line. Someone who had added a few fancy frills and has brought out what he is pleased to term a more artistic production. It is like red tape in a government office. It makes a very pretty border, but it is hell to unwind it. All the systems mean the same thing: "Get paid for what you do" and "Do all you can."

The question that the average workman always asks, and the one that is usually the hardest to answer is, "What is the price going to be?" It is not whether it is to be a "standard time" proposition or a "flat premium" or a "sliding scale" or "straight piece work." The question is, "What is the standard time going to be?" "Who is going to set it?" "How much do we get for it?"

No railroad management ever attempted to inaugurate a system of payment by output that did not guarantee the day rate. That is, no railroad that understood what it was trying to do. Any railroad management that would attempt this would be making a serious mistake.

As regards the efficiency of any one system over the other, actual results don't show enough real difference to argue about. I have been associated with four different plans of payment, at one time or another, and as far as I can see "straight piece work" seems to be as satisfactory as any for railroad work.

It is just as easy to set a correct price as it is a correct time. In fact a standard time and a standard day rate has to be settled on before a price can be set. It makes no difference whether a job is paid for at 60 cents per job or an allowance of two hours is made at 30 cents an hour. The question to decide is, not how this should be classified, or what name shall be given to the system—but how near does 60 cents come to being a fair value for the work done? How near is two hours to good time?

If a standard price is set, and it is found to be too high (and everybody knows that this will happen occasionally, even with the best of systems) it is an easier and simpler proposition to reduce the price than it is to reduce the standard time. A change of men will do the former in a majority of cases.

In a standard time proposition, a change of men would not do it, as the hour allowance is the same. If an attempt is made to reduce the cost by putting a cheaper man on a job, it is an acknowledgment that a mistake was made in the first place. This is the same thing exactly as getting a price too high.

A straight piece work price is the simplest standard of efficiency that can be found, because it is fixed. A man's earning sheet then is all that is needed. With a standard time list or a sliding scale sheet or a premium statement with a variation in time on any two of the same class of jobs, figuring out an efficiency standard would be an endless and unsatisfactory task. Something has to be fixed—the best thing is the price. A straight piece work price is simply a standard time record in a more compact and less bulky form. It is a standard time proposition carried out to its logical end and consequently more easily handled. It is settled upon and adopted by locating the exact point at which the maximum output line crosses the minimum time line.

All workmen grade themselves and their fellow workmen as to class by the prevailing hourly or day rate of the shop in which they work. No matter what may be a man's earning power or how much variation there may be between the lowest and the highest rate in a shop; it is the hourly rate that settles shop distinction.

Even the Santa Fe Railroad, which has the completest and most elaborate system of any railroad in the country, raised its hourly rates some time ago, when the labor agitation for increased pay was at its highest.

On a straight piece work road the standard is fixed, and it would simply be a matter of increasing the piece work prices a given per cent.; but even on a straight piece work railroad it is the day rate that is always in question. Then again, if on a standard time basis the workmen make big premiums, as they often do, the question is immediately raised whether or not the day rate is correct. Why, for instance, should a workman make 50 cents an hour on "bonus," working on a standard time basis, when the hourly rate in his territory is perhaps only 30 cents an hour? What is to be the standard? If the hourly rate is right, the standard time is wrong. If the standard time is right the hourly rate is wrong. Again comes the question, "Who is to say?"

A railroad that has trouble introducing piece work would have trouble introducing any other method of payment by output. A railroad that does not get satisfactory returns on piece work would have trouble with any other system. As far as actual history goes, piece work seems to have the advantage over all other systems. The Chicago, Burlington & Quincy, for instance, was the first railroad in the western territory to introduce piece work in its shops, and it had no labor trouble whatever. The Santa Fe Railroad was the first railroad in the same territory to introduce the bonus, or standard time system, and men went out over the entire system. This comparison may not be quite fair, as conditions may not have been quite the same, but it shows what actually happened.

The really proper way to decide this point is by comparing accomplishments. Some railroads introduced piece work many years ago, and the best individual effort, premium, or bonus systems brought out since are not able to get below the old prices. It is true that prices are lower in straight machine shop work in many instances, but this is due mostly to high-speed steel and improved machines, but even improved machinery in addition to improved systems of payment has been unable in some cases to reduce costs. This is true, not only because a few of the pioneer men in the railroad business understood the game, but because the ability of the individual operator is the greatest factor in any system. No records are made without the full and harmonious co-operation of the individual operator, and this is the key to the whole situation. The amount of personal work necessary to get a standard time list established, or the time of an operation reduced, would

get any piece work price established that was ever made, so the argument about cutting prices does not amount to anything. If the employer understands his men and works with them and devotes enough personal attention to them, the rest is easy.

In the general run of locomotive repair work only so many things are possible; a good high grade man ten years ago was the equal of a good man to-day.

Staybolts were driven ten years ago in boiler shops that I know of for $1\frac{1}{4}$ cents per end, on a straight piece work basis, and the men made good money. I should like to see any premium system that has improved on this.

Flues were taken out on a piece work basis to my knowledge in other shops more than eight years ago for $1\frac{1}{4}$ cents each and put in for 6 cents each on a straight piece work basis, and I have never seen a system yet that has been able to improve very much on this.

Driving box brasses were turned and fitted for 6 cents each on a piece work proposition when I first started to learn the trade, and the best premium price I have seen since does not even equal it. It is not how to keep track of what is done that counts; it is what you are keeping track of!

Locomotives have grown considerably larger and machines have gotten a little heavier in proportion in the last decade, but the actual work necessary for repairs has changed but very little. It is still just about as much physical work to put in staybolts or flues, do flanging, etc., as it was some years ago.

A shoe and wedge job in the erecting shop, for instance, takes just about as many moves now as a good man took then.

Machines rip stock off faster now and tires are turned quicker and straight machine shop work in general has been toned up considerably in the last few years, but very few men can chip and fit up a new pair of cylinders for less than \$12, which was a piece work price on a western railroad over 12 years ago. I have not heard of any bonus or premium system that has reduced this very much. It is not how you pay, it is how much you pay, that interests both the employer and the employee.

The hourly rate or the day wage standard of measurement will not soon be eliminated. All systems admit this when they use a day rate guarantee as an inducement for their adoption on trial.

East of the Hudson river, 25 cents is considered average railroad mechanics' pay. West of Philadelphia and east of Buffalo, 28 cents is considered an average. From Buffalo to Chicago it rises to 32 cents; from Chicago to Denver to 36 cents, and from Denver west, from 36 to 44 cents, according to location. This is the understood hourly rate. It changes now and then as conditions change, but the same proportion of difference always exists. This ratio is considered a standard and will be for years to come. A standard time proposition would be a very good thing. It could be used all over the country. If it took two hours to turn a pair of driving wheels in Connecticut, the price would be 50 cents a pair; at Buffalo, 56 cents; at Chicago, 64 cents, and so on. But what if the Connecticut man had a good lathe or was a faster man than the man out in Chicago? It would then make a difference. The same agreement holds good on straight piece work. Conditions have to govern every movement that is made.

No leak in a steam line was ever stopped by a lecture on British thermal units.

No adding machine ever increased the earning capacity of the man who takes the cuts and feeds in the shop. No card index ever reduced the time on setting valves in the round-house.

The foreman who says, "Come on Bill," we have got to turn drivers for 50 cents a pair or bore tires for 10 cents apiece, and then proceeds to get it done, has got a "system" that ties all the rest of them up to the wharf.

All a railroad has to do to make a success of any system.

is to put the matter in the hands of some practical, level-headed mechanic who can talk well and reason clearly and the results will be the same, whether it is called piece work or premium. All the systems of payment by output are on the right track. They all have their good points and they all have their weak spots. The real difference is not enough to argue about. At least, the actual results accomplished do not show it. It is the only way to work and it is the only way to pay. It represents a square deal, both to the employer and the employee, no matter what name may be given to it, and common sense and good judgment, I believe, can install and continue it on any railroad in the country.

SHOP SUPERINTENDENT.

STANDARD CODE RULE 94.

Chicago, July 28, 1908.

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

As the communication signed William Nichols in your issue of June 26 seems to be referred to me and others, I take pleasure in replying to the criticism on Rule 94 by quoting the rule, or, rather, its second paragraph, which, Mr. Nichols alleges, may, under the circumstances he cites, produce a collision. The rule itself disproves this charge. It reads thus:

"When a train, unable to proceed against the right or schedule of an opposing train, is overtaken between telegraph stations by an inferior train or a train of the same class having right or schedule which permits it to proceed, the delayed train may, after proper consultation with the following train, precede it to the next telegraph station where it must report to ——. When opposing trains are met under these circumstances, it must be fully explained to them by the leading train that the expected train is following."

The situation set forth by Mr. Nichols was as follows:

A	B	C	D	E	F
O	O	X	X	X	O

O—Telegraph station.

X—Non-telegraph station.

Trains affected:

Eastward—Extra 1 from A to F and No. 10.

Westward—Extra 2 and Extra 4 from F to A.

Extra 1 and Extra 2 have orders to meet at C.

No. 10 and Extra 4 have orders to meet at C.

Extra 4 and Extra 1 have orders to meet at D.

No. 10 overtakes Extra 1 at C, which is held there to meet Extra 2, which is held at D by the schedule of No. 10 and is overtaken there by Extra 4.

Mr. Nichols alleges that, under the rule, No. 10 may proceed from C, preceded by Extra 1 and Extra 4 may proceed from D, preceded by Extra 2, with possibilities of collision between C and D. But the merest glance at the rule will make clear the fact that No. 10, not having right or schedule which permits it to proceed from C, must remain there to meet Extra 4 and Extra 4 not having right (an extra has no schedule) to proceed from D, must remain there to meet Extra 1. The rule says explicitly that the overtaking train must have right or schedule which permits it to proceed. This right or schedule is its right or schedule, not part its and part that of the overtaken train, but plainly a right or schedule which would have permitted it to proceed had no train been overtaken. Whatever right or schedule may be held by the overtaken train is valueless under the circumstances provided for in the rule. That train has become wholly dependent upon the right or schedule of the overtaking train for the privilege granted by the rule of preceding it to the next telegraph station, and this fact is so clearly expressed in the rule itself that I am surprised that any railroad man at all versed in the rules should fail to grasp it. It is only by assuming the contrary, absolutely without warrant from the rule, that Mr. Nichols moves his trains from C and D, respectively, and incurs the risk of collision. His assumption

tion is, in effect, that Rule 94 permits two trains in the same direction, neither of which can proceed on its own right or schedule, to pool, as it were such right or schedule as each may possess and proceed on the combination right or schedule thus manufactured. But, plainly, the rule authorizes nothing of the kind. Whatever may be the case in grammar, in train rule interpretation two negatives do not make an affirmative.

Rule 94 provides an absolutely safe procedure under every imaginable combination that can arise, for it is clear that whenever a train has a superiority either of right or schedule which permits it to proceed, and this under the rule is indispensable, any other train may safely precede it, notifying opposing trains met that it is moving under protection of the superiority of the train following. The fact of superiority may be easily ascertained whenever the occasion arises. It is to ensure knowledge of this fact by the overtaken train that the rule directs that train to have proper consultation with the overtaking train before preceding it. Proper consultation, under the conditions prescribed in the rule, demands this knowledge. The overtaking train must satisfy the train preceding it that its superiority of right to proceed is unquestionable before the latter can safely rely upon that superiority to protect its movement ahead of the train holding the required authority either of right or schedule specified in the rule. But that authority must be possessed wholly by the overtaking train, the other train having wholly lost right or schedule permitting it to proceed when overtaken.

JOHN F. MACKIE.

LOOP EYES AND UPSET ENDS ON STEEL RODS.

BY MALVERD A. HOWE.

After having loop eyes and upset ends on steel rods fail under impact and in each instance finding that the fractured area was almost entirely crystalline in structure, the writer wonders if it was accidental or, if as a rule, all upsets and welds were crystalline.

To get information upon the subject, 28 "lateral rods" were

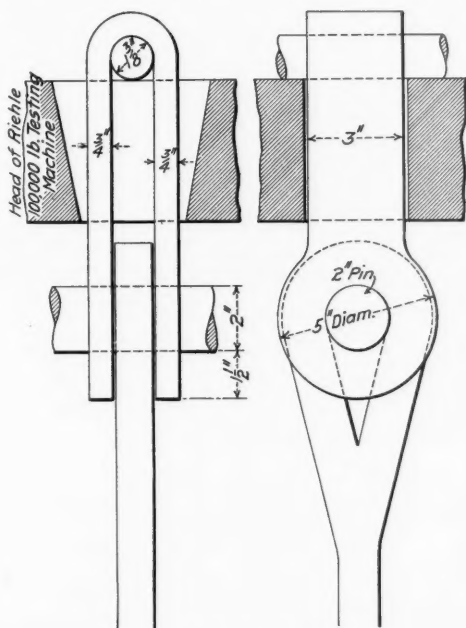


Fig. 1—Grip for Loop Eyes.

purchased in the open market, the rods being made to order. Each rod was about five feet long with a loop at one end for a two-inch pin and upset for a screw thread at the other end. Round and square bars were ordered in sizes varying from $\frac{1}{2}$ in. to $1\frac{3}{8}$ in., as indicated in column 1 of the tables. The steel was specified as Railway Bridge Steel according to the Manufacturers' Standard specifications, and no welds were allowed except in forming the loop eyes.

As received, the loops and upsets did not measure up to standard, but the departure was not very serious.

Each rod was cut into approximately three equal pieces, the center portion being designated as the body of the bar.

The body of the bar was tested for tensile strength in the usual manner with results shown in Table 1. Ten bars failed to fulfill the specifications for tensile strength, nine falling under and one going above. The elastic limit in each case

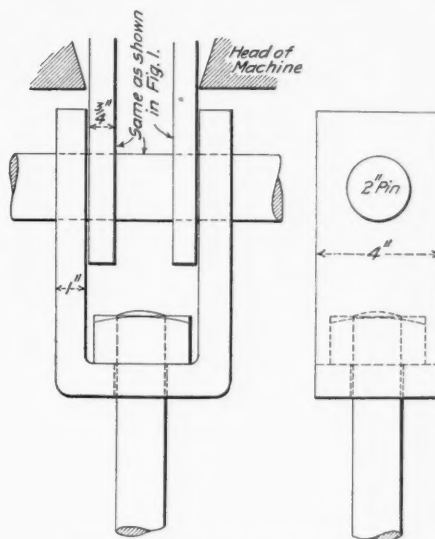


Fig. 2—Grip for Upset Ends.

fulfilled the specification. For the most part the fractures were silky.

TABLE 1.—Body of Bar.

1.	2.	3.	4.	5.	6.	7.
Mark	Size of bar	Per cent. Elongation	Reduction of area	Elastic limit	Ultimate strength	Remarks
1	$\frac{1}{2}$	28.0	51.4	43,100	61,300	Silky.
28	$\frac{1}{2}$	17.2	37.4	31,700	48,400	Silky; prtly crystalline
2	$\frac{1}{2}$	17.2	27.9	31,900	49,000	Silky.
27	$\frac{1}{2}$	23.4	57.0	41,900	61,300	Silky; crys. trace.
3	$\frac{5}{8}$	25.0	59.2	39,400	58,800	Silky.
26	$\frac{5}{8}$	30.0	59.3	41,000	60,000	Silky; crys. trace.
25	$\frac{5}{8}$	27.7	65.8	34,000	48,900	Silky; crys. trace.
4	$\frac{5}{8}$	22.2	53.9	32,800	45,000	Silky; fibrous.
23	$\frac{3}{4}$	37.5	23.7	62,500	100,500	Very small crystals.
5	$\frac{3}{4}$	28.2	47.7	32,500	54,200	Silky; crys. trace.
6	$\frac{3}{4}$	31.3	21.7	37,400	57,300	Silky.
24	$\frac{3}{4}$	50.0	60.0	37,400	57,800	"
7	$\frac{7}{8}$	33.1	66.1	38,400	59,900	"
22	$\frac{7}{8}$	32.1	56.7	39,200	59,400	"
8	$\frac{7}{8}$	32.2	55.6	35,400	59,400	Silky; crys. trace.
21	$\frac{7}{8}$	33.3	61.1	35,700	57,300	Silky.
19	1	31.3	59.2	39,500	56,000	"
10	1	28.8	75.3	34,900	53,500	"
20	1	16.4	69.0	31,000	47,400	Crys. trace open seams
9	1	25.0	39.8	28,600	45,800	Silky; crys. trace.
11	$1\frac{1}{8}$	30.5	58.4	38,800	60,000	Silky.
17	$1\frac{1}{8}$	30.5	64.9	36,000	56,800	"
18	$1\frac{1}{8}$	30.6	66.2	36,700	57,100	Silky; crys. trace.
12	$1\frac{1}{8}$	30.0	64.9	36,000	56,800	Silky.
13	$1\frac{1}{4}$	30.0	66.3	36,500	55,600	"
14	$1\frac{1}{4}$	30.0	60.3	38,600	56,600	"
15	$1\frac{1}{4}$	28.0	49.6	38,400	59,400	Silky; crys. trace.
16	$1\frac{3}{8}$	30.6	59.7	36,700	54,700	Silky.

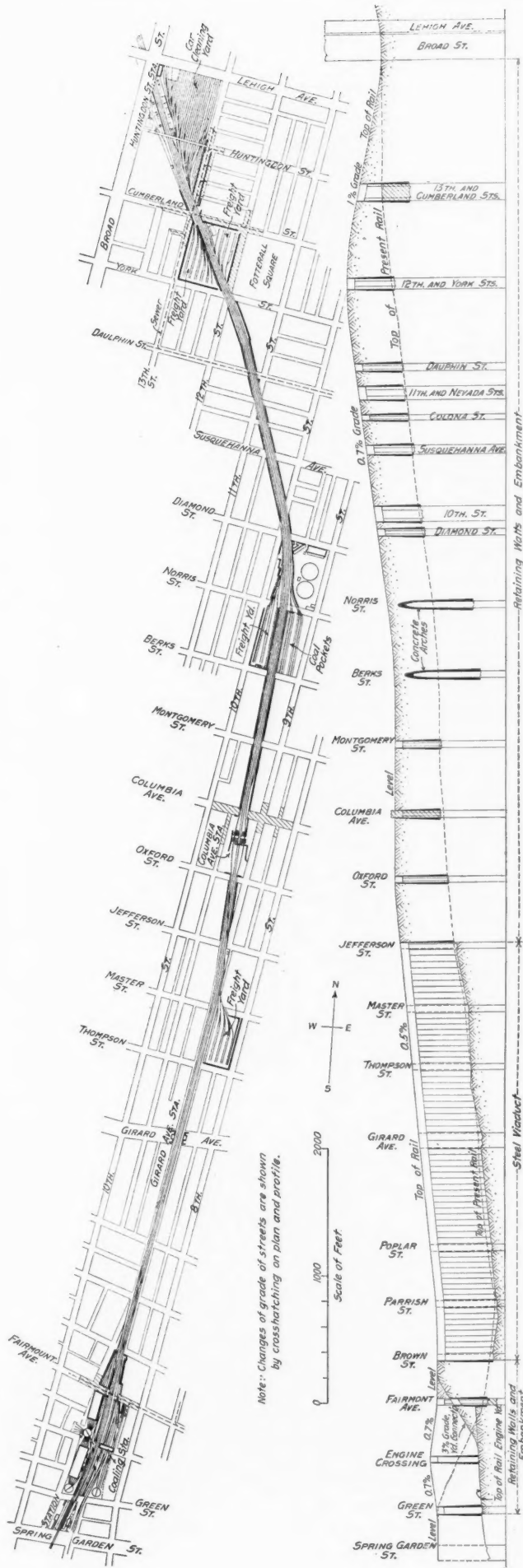
NOTE.—"Crys. trace" indicates that a very small amount of the fractured area was crystalline.

In testing the loop eyes and upset ends, in order to obtain a fair pull, special end connections were employed having two pins at right angles, as shown in Figs. 1 and 2.

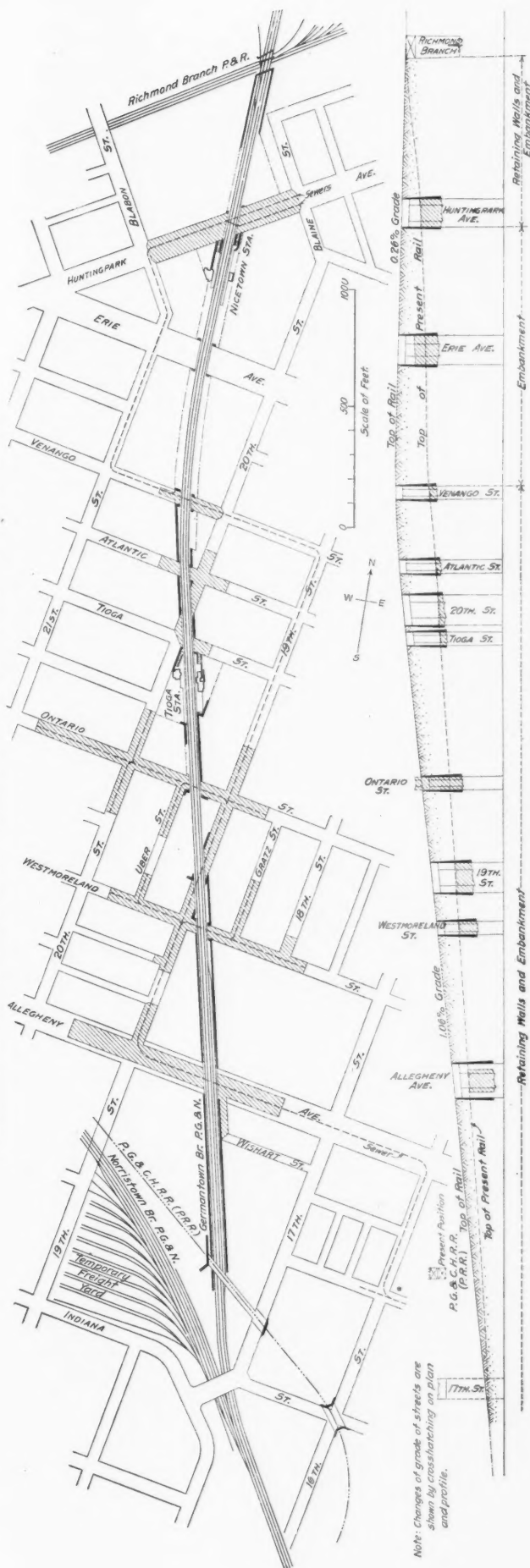
Tables II. and III. show the results of the tests of loop eyes and upset ends. In only one instance was the loop eye as strong as the body of the bar. The average relative strength of the loop eyes and the body of the bars was about 90 per cent.

In case of the upset ends five specimens showed a greater strength than the body of the bar, but, on the average, the strength was but about 90 per cent. the strength of the body of the bar.

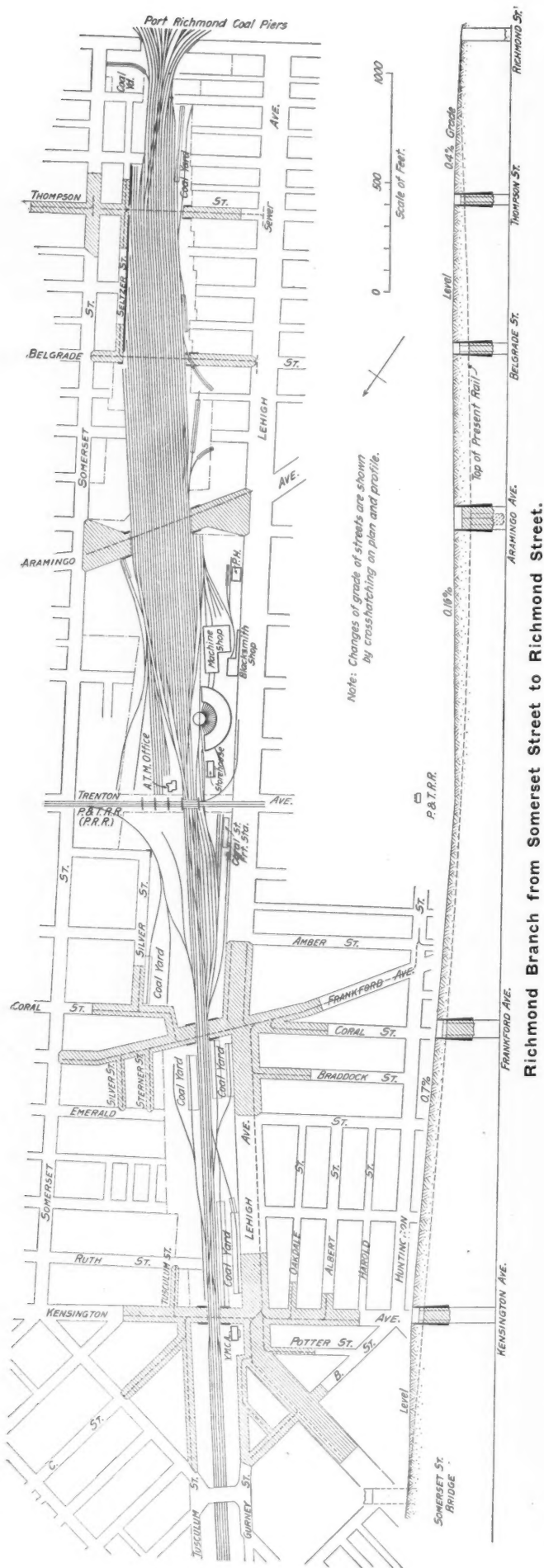
In practically every instance where failure occurred when the steel had been reheated to weld or upset, the fracture was



Philadelphia, Germantown & Norristown from Green Street to Broad Street.



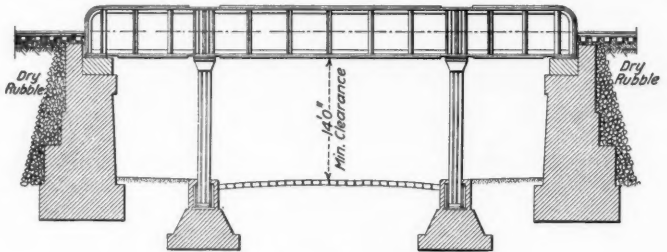
Philadelphia, Germantown & Norristown from Indiana Street to the Richmond Branch.



over all streets, as shown on another plan and profile. Allegheny avenue, Westmoreland, Ontario, Nineteenth streets and Hunting Park avenue, with a number of adjacent streets, are affected. The four tracks are to be carried between the streets on a solid fill with masonry, and over streets on steel bridges with solid waterproofed floors.

On the Richmond branch, in the northeastern part of the city, the tracks are to be elevated from the bridge at Somerset street to Richmond street. This section, as shown on the plan, includes a large yard. Aramingo avenue is to be opened to take the place of Cedar street, and Belgrade and Thompson streets, neither of which were formerly continued across the railroad, are to be opened and carried beneath it.

The extent of the work and the number of grade crossings



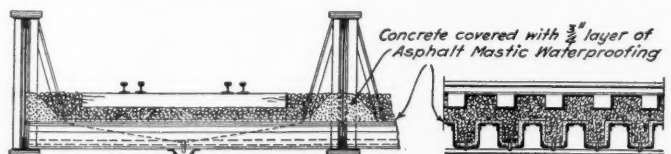
Bridge Construction Over Street.

which will be done away with are shown in the following table:

Section.	Length, miles.	Grade-crossings abolished.
1. P., G. & N. R.R., Green to Broad.....	2.2	21
2. P., G. & N. R.R., Broad to Richmond Br..	1.5	8
3. Richmond Branch	1.3	3
Total	5.0	32

The depression of some of the streets below the general drainage level has made necessary a large amount of revision of sewers. Nearly all of this work is under contract and well advanced. The new sewers are shown on the plans. The total cost of the sewer work now under contract will be about \$335,000. Work was started on most of the contracts in September, 1907.

At present, the work of elevating the tracks is under way between Columbia avenue and Broad street. At Berks street a temporary grade will be built to connect the present level with the new elevation. One of the drawings shows how this



Section of Bridge Over Street.

is being done. The railroad traffic, which amounts to 467 movements in 24 hours, is all carried on two temporary tracks on the west side of the line within the limits above given; the eastern wall, a temporary trestle to carry two tracks, a crib, and half of the bridges over the streets are being built. When this is completed, traffic will begin on the new high level and the western wall and the western portion of the bridges will be finished and the fill completed. At present the eastern retaining wall and the eastern portion of the bridge abutments, with the temporary trestle, are well under way.

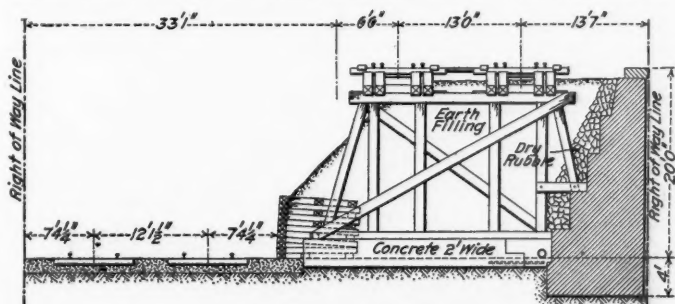
A temporary freight yard has been built on property of the railroad at Nineteenth and Indiana streets, to take care of the business which will be thrown out by the reconstruction of the yards to the new level. It will also provide facilities for the industrial establishments that will be temporarily deprived of direct track connections with the road.

At Wayne Junction, a temporary yard for the storage and care of engines has been built, with coal dock, engine shelter, water tanks and ash pit. This takes the place of the engine yard at Green street during construction.

The yards between York and Cumberland streets, formerly used for car cleaning, are being reconstructed, a new elevation, for freight use, and all the car cleaning transferred to the yard between Cumberland street and Lehigh avenue. Two other freight yards are to be elevated, with driveway ramps leading to them. These are at Tenth and Berks streets and Ninth and Master streets. The present engine yard at Ninth and Green streets is to be entirely rebuilt and the coaling station arrangements entirely changed.

Under the terms of the ordinance, the cost of the work, including all damages for change of grades of streets, etc., is to be evenly divided between the city and the railroad, except that the latter is to pay the entire cost of the additional tracks between Green street and Girard avenue; four tracks are planned here and but two tracks exist at present. The railroad is also to pay for any increased facilities which may be required. The city makes contracts for all changes of grade in streets, moving and rebuilding municipal structures, etc., and the railroad raises its tracks, constructs the bridges and does all the necessary railroad work. All contract plans are approved by both parties. It is estimated that the total cost of the work will be about \$10,000,000.

The Director of the Department of Public Works represents the city and the Chief Engineer of the railroad repre-



Section of Temporary Trestle.

sents that company. George R. Stearns is the Director of the Department of Public Works, and William Hunter is Chief Engineer of the Philadelphia & Reading. All general plans are also signed by Theodore Voorhees, First Vice-President of the railroad, and George S. Webster, Chief Engineer of the Philadelphia Bureau of Surveys, who has charge of the work for the city. In the field S. T. Wagner represents the railroad and James W. Phillips represents the city.

AUTOMATIC SIGNAL RECORDER.

The Lancashire & Yorkshire has in experimental use an automatic signal recorder, the objects of which are:—To obtain accuracy in the records of the signals sent and received between any two block signal cabins, accuracy in the time the signals were sent and received, relief of work on the part of the signal-man and to do away with train bookers.

The principle involved is to record the signals in the form of time, and the instrument is in electric series with the [manual] block telegraph instruments.

The instrument consists essentially of a recording apparatus, by which the signal, as recorded, is expressed in the form of time at which it was transmitted, that is, as a "Time Stamp Signal" recorder, which gives simultaneously the signal and the time it was sent. Thus a single bell call would be expressed in time, 5:20:2., and a double bell call by a repetition thus,

5:20:2.

5:20:2.

The apparatus consists of three parts mounted on a suitable wooden base. These parts are:—(1) The time clock. (2) The time stamp wheel motor. (3) The paper motor. The time stamp wheel clock drives two sets of 3 wheels arranged parallel and close to one another on concentric spindles. These wheels

have figures engraved on their periphery representing hours, minutes, and tenths of minutes respectively, and they are so arranged that the figures representing the time at any tenth of a minute lie in a row under two rubber-faced hammers, actuated by electro-magnets. Between the hammers and these type wheels a paper ribbon and an ordinary typewriter ribbon are placed so that when the hammers are actuated the time is stamped on the paper ribbon. The type wheels are operated every six seconds by the time clock (1). A signal other than a single beat is expressed by the position of the line of numerals.

A treble bell call with a pause between the second and third strokes is expressed in two lines, a space and a single line,

5.20.2.
5.20.2.

5.20.2.

A sample of a record is shown below.

Samples of Records Made With Automatic Signal Recorder.									
Bullfield.			T. O. L.		1 51 6	Y. W. A.		1 58 7	
Fast.					1 51 6	EXP.		1 58 7	
19.	10.	7.					PASS.	1 58 7	
Att		1 49 8	1 52 6		L. C.		1 58 7		
1 49 9		Ack	1 52 6				Att		2 3 0
			Ack		1 52 6		2 3 0		Ack
I. L. C.		1 49 9					I. L. C.		2 3 0
Exp.		1 49 9	1 58 6		ATT		Ord.		2 3 0
Pass.		1 49 9					Pass.		2 3 1
		1 49 9	ACK		1 58 6				2 3 1
1 50 0	Y. W. A.		1 58 6		I. L. C.		2 3 1		Y. W. A.
1 50 0	Exp.		1 58 6		EXP.		2 3 1		Ord.
1 50 0	Pass.		1 58 6		PASS.		2 3 1		Pass.
1 50 0			1 58 6				2 3 1		

Explanations.

Att—Attention signal.
Ack—Acknowledgment.
Y. W. A.—Yes, will accept.
T. O. L.—Train on line.
L. C.—Line clear.

Italic type denotes down-line traffic.

THIS STYLE TYPE DENOTES UP-LINE TRAFFIC.

REPORT OF CANADIAN PACIFIC CONCILIATION BOARD.

The Board of Conciliation appointed by the Minister of Labor of Canada to adjust the differences between the Canadian Pacific and certain of its union employees has rendered its report. The report is signed by two of the arbitrators, P. A. McDonald (Chairman), and G. F. Galt, and is dissented from in certain particulars by the third, James Summerville, the representative of the employees.

The dispute arose from the action of the road in notifying the men in the mechanical departments on its western division of the termination of certain agreements regulating the relations between the company and these particular classes of employees. The board began the taking of evidence at Winnipeg on June 4, 1908, and completed this work on July 8, but its report was not made up until two weeks later. Following is a summary of the findings of the board:

That the definition of the machinists' trade should be altered by eliminating the clause, "Drill presses, where a boring or facing tool is required, shall be operated on such work by machinists or apprentices."

In place of the old definition of a boiler-maker, the company submitted the following:

"First-class boiler-makers to do testing, laying-out, fitting-up and patching. Second class boiler-makers to do riveting, caulking, stay-bolting and tender work. Tubers, front end and back end. Netting and ashpan men."

On this question the board finds in favor of the company. The result of this finding being to add a class No. 2, to this trade, it becomes necessary to fix a rate therefor, and the board accordingly fixes such rate at 40 cents an hour.

The company first contended that it should not be required to recognize committees on grievances, but the board finds in favor of the men and recommends the adoption of the following clauses:

"Employees having grievances, either specific or of a general nature, may present the case to the proper officer. If investigation is desired the aggrieved party, or another employee representing him,

may, during work hours, arrange with his foreman for same. Investigation to be held within 48 hours after such application, and in case a satisfactory adjustment cannot be made, the case may be referred to the next higher officer of the department, until the manager is approached. If, after investigation, the employee is found blameless, he will be paid for all time lost."

In all the trades the proportion of apprentices to journeymen had been fixed at one to five and one for the shop. The board found that in no trade except that of the machinists was injustice being done on either side by this proportion, but that in the case of the machinists the evidence was that a large number of applicants were prevented from learning the trade by reason of the limitation contained in this rule; and the board expressed the opinion that the proportion might be made one to four and one for the shop in the machinists' trade without injuring the education of the apprentices, and that the necessity for skilled labor and the desirability of retaining and developing the boys of the country rather than importing foreign mechanics justified the board in favoring this increase.

The company wished to abolish the rule providing that when expenses are to be curtailed there should be a reduction in time of the whole staff, and to substitute for it a rule to permit a reduction of the staff, with a provision that those remaining in its employ should work a full day. The board recommends that no change be made in this rule.

The board found in favor of the company on its demand for the expunction of the clause in the machinists' schedule, which provided that in case of wrecks, where it is necessary to disconnect or replace engines on the track, two machinists shall accompany the wrecking crew.

The company proposed that instead of all employees beginning at 7 a.m. and quitting at 17 o'clock, part of the force should work these hours and part should begin at 8 a.m. and quit at 18 o'clock, so that there might be continued work in the roundhouse with a diminution in overtime. The board recommended that this change be made. The board refused to recommend that helpers to machinists be allowed to use tools under the direction of the machinists.

The board recommended that the foregoing findings should apply to disputes between the company and its men on the eastern division as well as on the western division.

The men asked for a nine-hour instead of a ten-hour day, with an increase in pay to make their earning capacity under the nine-hour equivalent to what it was under the ten-hour day. Representatives of the company said it would have no objection to this change if its competitors also made it; but the board refused to recommend any such readjustment of hours and wages, holding that present business conditions would not justify it. It held that the schedule should be arranged by negotiations between the company and its western and eastern men, to be carried on at Winnipeg and Montreal, respectively.

It was held that "car men" are entitled to the benefit of the foregoing findings of the board. It was recommended that the settlement should become effective on August 1, 1908, and continue in effect until April 1, 1909.

WESTINGHOUSE SIGNALS IN THE EASTERN HEMISPHERE.

In a recent pamphlet publication the Westinghouse Brake Company of London describes the electro-pneumatic block and interlocking signals which have been erected by that company within the last few years on the underground railroads of London; and, in connection therewith, prints a list of the installations of these signals in other countries outside the United States. This list is copied, somewhat condensed, below. The names of the London "tubes" in which these signals are in use are:

The Metropolitan District.
The Baker Street & Waterloo.
The Great Northern, Piccadilly & Brompton.

The Charing Cross, Euston & Hampstead.
The Metropolitan.

In some of the tubes there is so little space at the side of the track that the air cylinders and other apparatus of switch movements have to be fixed on the side of the tube, four or five feet above the level of the rail, with curved and jointed rods to make the connection to the rail.

Westinghouse Electro-Pneumatic Interlocking Signals.

Great Britain:	Railroad.	Machines.	Points.	Signals.
Granary Junction.	Great Eastern	1	43	25
Bolton	Lancashire & Yorkshire	..	43	126
Liverpool	Lancashire & Yorkshire	..	..	..
Tyne Dock	North Eastern	5	114	173
Hull	"	2	99	178
Newcastle	"	5	186	391
Newcastle	"	4	180	366
Glasgow	Caledonian	1	106	251
London	Metropolitan District.	14	217	331
"	Baker St. & Waterloo.	5	15	32
"	Great Northern, Piccadilly & Brompton.	5	18	37
"	Great Northern & City	..	..	..
"	Charing Cross, Euston & Hampstead	6	27	35
France:				
Orleans	Paris-Orleans	1	53	45
Les Aubrais	Paris-Orleans	1	73	34
Paris	Eastern	1	10	15
Germany:				
Mainz, Worms, etc.	Prussian State	14	383	202
Munich	Bavarian State	1	10	4
India:				
Howrah	East Indian	2	100	133
Egypt:				
Cairo	Egyptian State	3	76	74
Australasia:				
Brisbane	Queensland	1	16	22
Sydney	New South Wales	..	64	91
Dunedin	New Zealand	2	64	80
Total outside America		77	2,006	2,848
Total in America, about		350	8,700	8,150

Westinghouse Automatic Block Signals on Electric Railroads.

Railway.	Miles of track.
Metropolitan District (London)	53 1/2
Baker Street & Waterloo (London)	8
Great Northern, Piccadilly & Brompton (London)	18
Great Northern & City (London)	9 1/10
Charing Cross, Euston & Hampstead, 119 signals	..
Lancashire & Yorkshire (Liverpool)	1 1/2
Boston Elevated	22
North Shore (California)	20
Interborough Rapid Transit (New York)	43
Long Island (Brooklyn)	52
West Jersey & Seashore	70

The number of Westinghouse automatic block signals in America, including both electric and electro-pneumatic, is given as 28,500.

INSTRUCTION OF EMPLOYEES ON CHICAGO & ALTON AND TOLEDO, ST. LOUIS & WESTERN.

P. H. Houlahan, General Manager of the Chicago & Alton and the Toledo, St. Louis & Western, has inaugurated a new system of instructing the employees of these roads regarding their duties. As stated by the *Railroad Age Gazette* July 10, page 492, meetings between division officers and employees of the operating department are being held at division terminals at 2 p.m. on the first and third Mondays of each month. A board of supervision has been created which is composed of the division superintendents and their staff officers, supplemented by representatives of the traffic department. The superintendent is the permanent chairman of such meetings, and a competent stenographer acts as secretary and takes a full report of the proceedings.

The subjects considered are every-day problems arising out of the operation of the roads, and they are discussed from the standpoint of safety, expediency and economy. The discussions are informal and are participated in by all present, parliamentary rules prevailing. Suggestions from all sources are threshed out until only points of leading importance remain unsettled, and these are either settled by the officers in attendance at the meeting or, if the chairman prefers, are referred to the general manager for disposition, and his decision is announced at the next divisional meeting.

At the conclusion of each meeting, the secretary's records

are consolidated into a report, copies of which are sent to interested officers in all departments of the road. The advantage claimed for this method is that not only is the entire management advised of the conclusions arrived at, but each division gets the benefits of the discussions at the meetings on the other divisions, and the men who issue the instructions and make the rules, and those who execute them, become uniform both in their understanding and in their performance of their duties.

The Chicago & Alton formerly had an instructor who confined his efforts wholly to the interpretation of train rules; discussion by employees was not invited. It is claimed that the present system is better because the employees develop into a set of men possessing a clear understanding of the spirit and application of all rules and instructions. A similar system of instruction has been used on the Toledo, St. Louis & Western ever since Mr. Houlahan has been connected with it, but it has not been so broad in its scope and has not taken in every phase of operation, as it is believed that the system now in effect on both the Alton and the Clover Leaf does. It is stated by the management that the employees are entering into the discussions and applying to their work the lessons learned in a manner that shows that the system of instruction now being employed is establishing the proper esprit de corps that will help to accomplish the ends aimed at. An instruction car is used to convey the officers to the various meeting points.

THE USE OF SUPERHEATED STEAM IN LOCOMOTIVES.

BY DR. WILHELM SCHMIDT.

III.

(Concluded from page 570.)

We have seen that, in order to dry the boiler steam and to superheat it 200° F., about 25 per cent. of the total tube-heating surface of the boiler has to be employed in the superheater. In average boilers, as already mentioned, about 40 per cent. of the heat transfer is done by the fire-box, and only 60 per cent. by the tube-heating surface; from the latter, 25 per cent. is taken away to be used in the superheater, and thus the evaporative power of the boiler is only reduced by—

$$\frac{25 \times 60}{100} = 15 \text{ per cent.}$$

As the author has shown in the first article, the water economy effected by superheating amounts to more than 40 per cent., from which it follows that there remains an increase of at least 25 per cent. in steaming capacity, although the evaporative heating surface has been reduced by the application of the superheater.

In practice superheated steam locomotives have invariably shown themselves to be very good steamers, and this important fact has been a strong and favorable point in connection with their steadily increasing adoption.

The principal advantage of the saturated steam compound locomotive as compared with the saturated steam simple engine, lies in the fact that the former allows of a wider range of expansion by means of higher boiler pressures, while at the same time it reduces the losses by initial condensation in the cylinders. The latter advantage will be dealt with later; we shall, therefore, first consider the question of boiler pressure.

As a further improvement of the compound system, several railways employ the system in conjunction with superheated steam. This particular phase of the subject will receive special attention in this article.

HIGH STEAM PRESSURES IN LOCOMOTIVE SERVICE.

The application of the compound principle to locomotives has necessarily brought about the adoption of higher steam pressures. Starting, perhaps 20 years ago, with about 170 lbs.,

modern four-cylinder compound locomotives nowadays have boiler pressures ranging from 200 lbs. to 225 lbs. per square inch.

With respect to the efficiency of the engine alone, this increase in boiler pressure means a decided improvement; in fact high steam pressures constitute an essential feature of the compound system. But in some cases, especially in the United States, equally high boiler pressures have also been applied to ordinary simple locomotives; consequently it will be advisable to consider the question as to the economical limit of steam pressure in locomotive service, with reference to both simple and compound engines.

The theoretical advantages of high boiler pressures is shown

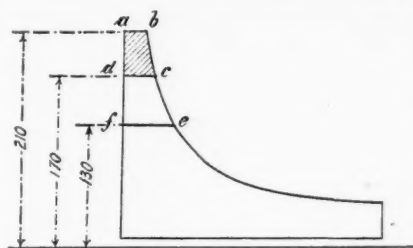


Fig. 7.

in the diagram, Fig. 7. By raising the steam pressure from 130 lbs. to 170 lbs. per square inch, it will be seen that from each pound of steam an increase of work indicated by the area e, f, d, c, can be obtained, whereas the gain due to the augmentation in pressure from 170 lbs. to 210 lbs. is only c, d, a, b, where c, d, a, b, < e, f, d, c. From the gain indicated by these areas the excess in heat expenditure for the generation of the higher steam pressures would have to be deducted. But as steam of 210 lbs. per square inch contains only 1 per cent. more heat than steam of 130 lbs., this factor can be altogether ignored. Thus these areas may be considered as the net theoretical gains. But we see that even the theoretical gain in work for each pound of steam does not increase at the same rate as the pressure, and this is especially the case with the higher pressures.

Assuming a perfect engine, working on the Rankine cycle and with 5 lbs. back-pressure, the theoretical increase of the thermal efficiency would be:

15 per cent. by increasing the boiler pressure from 130 lbs. to 170 lbs. per square inch.

8.8 per cent. by increasing the boiler pressure from 170 lbs. to 210 lbs. per square inch.

In practice, of course, the gain would be considerably smaller.

In simple engines, however, about 170 lbs. per square inch is

the limit of steam pressure which can be economically expanded in one cylinder, and only up to this limit can the gain above referred to be realized.

Professor Goss, of the Purdue University, made an extensive research in order to determine the value of high steam pressures in simple engines. In Fig. 8, taken from Professor Goss' report on this matter, the curve, A-B, shows the theoretical gain of a perfect engine according to each increase of steam pressure, whereas the curve, C-D, represents the actual performance of an engine on his testing plant.

Above 170 lbs. per square inch, very little gain in economy is shown.

If in some cases higher pressures are used in simple locomotives, then the only object is to increase the power of the engine with a limited size of cylinder, in spite of the reduction in economy in other directions. The diameter of the pistons

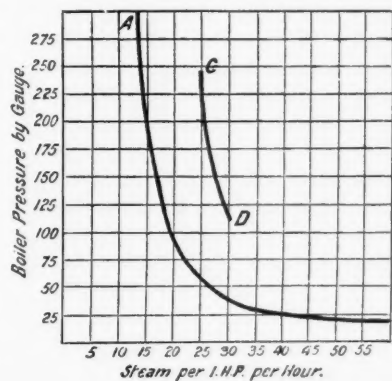


Fig. 8.

is limited either by the inside cylinder arrangement or, as is mostly the case, by fear of cylinder condensation. But, when using highly superheated steam, no condensation takes place, and the cylinder dimensions can then be increased within the limits imposed by the adhesion weight, without raising the boiler pressure above the economical limit.

Hence in the use of highly superheated steam in single locomotives, we have a cheap means at hand for enabling us to employ large cylinders instead of large and heavier boilers. Where the requirements of speed and balancing render it necessary, the four cylinder simple locomotive may be adopted.

But, returning now to the case of compound locomotives working with high steam pressure. The steam is expanded in two stages. Assuming, for instance, a ratio of the low-pressure to the high-pressure cylinder volume of 2.5, and 40 per cent. cut-off in the high-pressure cylinder, the nominal expansion would be:

$$2.5:0.4 = 6.25,$$

which allows of an efficient use being made of the expansive force of high-pressure steam, in that it lowers the terminal pressure. In a single-expansion engine with the same cut-off, the nominal expansion would only be:

$$1:0.4 = 2.5.$$

This is the principal reason for the advantages which the employment of high steam pressures may offer in compound engines. This gain is very pronounced at slow speeds with heavy loads and late cut-offs, but it practically disappears at high speeds, as then the wire-drawing of the steam lowers the terminal pressure of expansion and since it is obvious that this latter condition applies equally to the simple engine, it follows that, at high speeds, the expansive force of high-pressure steam is already fully made use of in single-expansion cylinders. Hence compound locomotives do not offer the same advantages at high speeds as at low speeds.

INITIAL CONDENSATION IN COMPOUND LOCOMOTIVES.

The second advantage of the compound system is the reduction of cylinder condensation, the range of temperature in each cylinder being smaller. The difference between the temperature of the admission steam and that of the exhaust steam in each cylinder of a compound engine is smaller than in the single-expansion cylinder: hence, the difference between the temperature of the admission steam and that of the cylinder walls will also be smaller, thereby reducing the condensation in each cylinder. But, on the other hand, the amount of metallic cooling surface is much larger in the compound than it is in the simple engine, on account of the larger cylinder. The total initial condensation in both the high and low-pressure cylinders is that due to one single-expansion cylinder of the diameter of the low-pressure cylinder, for the same range of pressures.

In practice, it has been found that the initial condensation, which, in the case of the simple saturated-steam locomotives, amounts to approximately 35 per cent., may only be reduced, in the case of saturated steam locomotives, to about 20 to 25 per cent.

By the use of highly superheated steam (of about 60 deg. F.) in the simple engine, however, this loss can be entirely avoided, and it is to this fact that the simple locomotive working with highly-superheated steam, owes its economical superiority over the compound locomotive using saturated steam.

The question now arises as to how far the economy of the compound locomotive can be increased by the use of superheated steam.

SUPERHEATED STEAM IN COMPOUND LOCOMOTIVES.

In this connection three different methods have to be considered: (a) Initial Superheating; (b) Two-stage Superheating, and (c) Intermediate Superheating.

(a) Initial Superheating. The live steam only is superheated, but to a sufficiently high temperature, to prevent condensation in both the high and low-pressure cylinders.

For this purpose, an initial superheat averaging 25 per cent. less than that in the simple engine is required. Thus, for the generation of each pound of steam of 170 lbs. pressure, superheated sufficiently to avoid all losses by condensation, there will be needed:

In the simple engine, about 1,330 B.T.U.

In the compound engine, about 1,295 B.T.U.

The saving in coal effected by the superheated steam compound locomotive over that of the superheated steam simple locomotive, for the same range of pressure, would therefore

$$\text{only amount to } \frac{1330 - 1295}{1330} \times 100 = 3 \text{ per cent.}$$

Taking into consideration, further, the better thermal efficiency of the compound engine, on account of the higher steam pressure used, and the reduction of leakage losses in the high pressure cylinder, the actual coal economy will be somewhat larger.

The opinion has frequently been put forward that in the case of the compound locomotive the size of the superheater can be appreciably reduced, by which means an appreciable increase in the steaming capacity of the boiler can, it is supposed, be obtained. This is not quite the case. We have seen that a large part of the work of the superheater always consists in the evaporation of the water carried over into it, and this part of the work is the same for either compound or simple locomotive superheaters. Thus it follows, that the permissible reduction in superheat (25 per cent.) in the case of the compound, cannot be followed by an equal decrease in the size of the superheater. Assuming, for example, 170 lbs. per square inch boiler pressure and 5 per cent. moisture in the steam passing to the superheater, then about one-third of the superheating surface must be used for the evaporation of this moisture, and only two-thirds remain for the superheating proper. If the total tube heating surface of the boiler (evaporating and superheating surfaces combined) be called = H, then the superheater of the simple locomotive may have a superheating surface of 0.3 H, of which two-thirds only, i.e. 0.2 H, are used for superheating proper, whereas 0.1 H is used for the evaporation of the moisture in the steam. In the case of the compound the first mentioned part of the superheating surface may be kept 25 per cent. smaller (i.e., 0.15 H), whereas the other part, used for the evaporation of the moisture, remains the same. Hence the total heating surface necessary in the compound locomotive superheater will only be:—0.1 H + 0.15 H = 0.25 H, as against 0.3 H in the case of the simple engine.

The permissible decrease in the size of the superheater in the case of the compound will then be about:

$$\frac{0.3 - 0.25}{0.3} \times 100 = 17 \text{ per cent.}$$

Thus, although the reduction in superheat amounts to 25 per cent., the decrease in the size of the "compound" superheater will only be 17 per cent. If, say, for a certain size of boiler, 18 superheater elements are required in the case of the simple engine, then 15 elements would suffice in the case of the compound. Of course, this reduction of the superheating surface means at the same time an increase of the ordinary evaporating surface (5 per cent.), and consequently an increase of the steaming capacity, of the boiler. Therefore, by the use of highly superheated steam in compound locomotives, some advantages respecting coal economy and steaming capacity may be obtained, as compared with the employment of such steam in simple locomotives. But it remains to be seen whether these advantages are not counterbalanced by the practical difficulties arising from high boiler pressures, especially as regards increased weight, initial cost, cost of repairs and maintenance of the boiler, cylinders, pipings and fittings. On this question the authorities of the principal railways on the Continent are not yet agreed.

(b) Two-stage superheating. In this second method the live

steam is only superheated sufficiently high to prevent condensation in the high-pressure cylinder, whereas a second superheater is supplied to obviate the losses in the low-pressure cylinder. At the long cut-offs generally used in the high-pressure cylinder, an initial superheat of approximately 100 deg. F. will be sufficient to obviate condensation in this cylinder. Then another superheater has to be employed for the low-pressure side. According to tests made with stationary engines, the bi-stage system, so far as the work of the engine is concerned, has proved less economical than the simple plan of highly superheating the high-pressure steam once and finally. But even if this loss could be overcome in the locomotive by utilizing waste gases only for the low-pressure superheater, and thus improving the boiler efficiency, there still remains the difficulty of arranging two superheaters in one boiler, whereby the receiver superheater must not only have a considerable heating surface, but also, on account of the increased volume of the steam, a large sectional area in order to avoid throttling of the receiver steam.

The increased weight and cost of construction and maintenance of such an arrangement would certainly more than counterbalance any small economical gain resulting from it.

It has also been proposed to superheat the boiler steam to a moderate degree only, and to arrange an auxiliary feed of superheated steam from the steam-pipe to the receiver, with the object of drying and superheating the receiver steam. This, however, would require such a large supply of live steam to the receiver, that the proposition is an altogether impracticable one.

(c) Intermediate superheating. Since this method consists of superheating the receiver steam only, it cannot have any superiority in economy as compared with the first-mentioned system, because the wetness of the boiler steam and the losses through condensation in the high-pressure cylinder still remain.

The first plan, viz., high initial superheating, seems, therefore, to be the most advantageous form of applying superheated steam to compound locomotives. Compared with the use of superheated steam in simple locomotives, a small gain in coal consumption and a somewhat increased boiler capacity can be expected.

CYLINDER PROPORTIONS OF SUPERHEATED STEAM SIMPLE AND COMPOUND LOCOMOTIVES.

The application of the compound system to saturated steam locomotives has not generally produced advantages as great as those obtained in either stationary or marine practice. The reason for this lies in the great variation in work required from locomotives, for performing which the compound system is not sufficiently elastic. The cylinder volume ratio can only be taken as a compromise, i.e., it is suited to the average high-pressure cut-off; but on the other hand, the working conditions of the locomotive undergo frequent changes irreconcilable with maximum efficiency.

By increasing the high-pressure cut-off in a compound locomotive above the value for which the cylinders have been proportioned the work done in the smaller cylinder is not increased correspondingly, because the receiver pressure, acting as back pressure in the high-pressure cylinder, is also increased. The whole augmentation in work comes practically on the low-pressure side. There the pressure during admission, and also the cut-off, is increased. The total work of the engine will not be equally divided between both cylinders; losses of pressure occur in the receiver; the engine does not work with its maximum efficiency, and the economy expected from the two-stage expansion is partly or even wholly lost.

These conditions are improved in the case of compound locomotives fitted with independent valve-gears, allowing the high or low-pressure cut-offs, or both, to be adjusted separately. But this, of course, introduces further complications.

This is the principal cause of the lack of adaptability of compound locomotives; and this position will not be improved by the application of superheated steam.

To get the highest range of expansion, large low-pressure cylinders are essential. In two-cylinder compounds, the ratio of cylinder volumes, in most cases, is practically limited to about 1:2; in four-cylinder compound locomotives this ratio can be made larger, up to 2, 8, and more.

When using highly superheated steam, however, it is not advisable to make this ratio too large, so as to reduce the high-pressure cylinder wall temperature; otherwise difficulties with the lubrication may arise.

Four-cylinder compound locomotives offer further advantages:—the division of the driving stresses over four cranks; the more uniform torque, the natural balancing of the reciprocating parts, and a smoother exhaust beat. But most of these features may also be obtained with four-cylinder simple engines.

With regard to the cylinder proportioning of superheated steam simple engines, the following points have to be considered. In order to utilize the increased working capacity of the superheater boiler, it is not sufficient merely to lengthen the cut-offs above those used in the saturated steam engine; for the losses due to insufficient expansion, increased back-pressure, and forced draught on the fire, would at least partly counterbalance the greater efficiency obtained by the use of superheated steam. Only by a corresponding enlargement of the diameter of the cylinders can the tractive power of the cylinders be increased sufficiently to use in an economical way the augmented capacity of the boiler.

As a rule, the cylinder volume of locomotives working with highly superheated steam may be made about 20 per cent. larger than that of ordinary locomotives of the same size, provided that the adhesion is sufficient to obviate slipping. And this is mostly the case, because at the usual speeds and cut-offs, in cases where the boiler is taxed to its utmost, and where the advantages of the superheater chiefly come in, the adhesive weight, is generally not fully made use of. In starting a superheater engine, however, with the link in full gear, the enlarged cylinders render the throttling of the steam generally advisable. Superheated steam locomotives not only start quicker by reason of their greater cylinder capacity but also because, in contradistinction to ordinary locomotives, they are not hampered by water in the cylinders.

On account of their bigger cylinders, superheated steam locomotives can be given a larger steam lap, and they start in full-gear with shorter cut-offs as compared with ordinary locomotives. All superheater locomotives on the Prussian State Railways, for instance, have 1½-in. steam lap, with from 5½-in. to 5¾-in. maximum valve travel, and these engines start in full-gear with from 60 per cent. to 70 per cent. cut-off. With this shorter cut-off, they can develop a somewhat greater starting power, without slipping, than the non-superheater engines of the same weight can do with 80 per cent. cut-off (even when, in the latter case, the engines are at their limit of adhesion), because with the shorter cut-off the torque becomes more uniform, and hence the chances of slipping are reduced.

The main advantage of the larger cylinders, however, lies in the smaller and, therefore, more economical cut-off, which can be used while the engine is being forced. A certain alteration in cut-off in a "large-cylinder" engine produces a greater change in tractive power with economical cut-offs, and the engine becomes more flexible. Special requirements in regard to balancing and a more regular torque, may render advisable the employment of four-cylinder express engines; but even in such cases, for the reasons given above, it may safely be concluded that four-cylinder simple locomotives, using highly superheated steam, and working with a moderate boiler pressure, will in future be deemed the most economical type.

SUMMARY OF CONCLUSIONS.

From the preceding notes the following conclusions concerning the use of highly superheated steam in locomotives may be drawn:—

- (1) If steam after its generation in the boiler is further

heated but without being in contact with water, it becomes superheated; its temperature and volume increase, while the pressure remains constant.

(2) By the use of highly superheated steam (*i.e.*, steam of approximately 600 deg. Fahr. temperature) in locomotives, a substantial reduction of steam and coal consumption, besides a large increase in haulage power, can be effected.

(3) The main source of steam economy, and consequently of coal economy and of the augmentation in haulage power, are the increased volume and the low conductivity of heat of highly superheated steam.

(4) The volume of superheated steam increases proportionally to its temperature and this is one of the reasons for the greater economy obtained with the higher degrees of superheat.

(5) The losses due to cylinder condensation in saturated steam locomotives vary from 30 to 50 per cent. and more.

(6) The transference of heat from the steam to the cylinder walls is the main cause of the loss due to initial condensation. This loss becomes smaller as the degree of superheat is increased on account of the lower conductivity of heat in the case of the highly superheated steam. This is another important point in favor of using a high degree of superheat.

(7) If heat is taken from saturated steam by cooling, or by doing useful work during expansion, a corresponding part of the steam is condensed, this part losing its capacity for doing work.

(8) Superheated steam may be cooled in the cylinders by the same amount to which it has been superheated in the boiler, before causing any condensation. It is, therefore, only necessary to superheat the steam sufficiently high, *i.e.*, to about 600 deg. F., and all losses by condensation in the cylinders can be avoided.

(9) The saving in water and coal does not increase proportionally with the degree of superheat. Moderate degrees of superheat do not effect any material economy.

(10) Losses due to leakage do not increase by the use of superheated steam: tests made by different authorities even show a reduction of these losses in superheated steam engines.

(11) The total economy in water in a highly superheated steam simple locomotive amounts to approximately 40 per cent.

(12) The economy in coal is generally smaller than the economy in water, on account of the heat expenditure required to superheat the steam. The latter is about one-tenth of the total heat required for the generation of the steam.

(13) The economy in coal of highly superheated steam simple locomotives, as compared with the coal consumption of ordinary engines, averages about 25 per cent.

(14) This saving in coal is tantamount to an increase in boiler capacity of 33 per cent., or, in other words, for equal quantities in coal consumed in each engine the superheater locomotive produces 33 per cent. more indicated horse-power than the saturated steam locomotive.

(15) An increase of 33 per cent. in the indicated horse-power may represent at high speeds a gain in draw-bar horse-power of 50 per cent. and more.

(16) The cylinders of highly superheated steam locomotives are usually made 20 per cent. larger than those in ordinary engines, in order to make use of the increased capacity of the superheater boiler, with economical cut-offs in the cylinders.

(17) High degrees of superheat can only be produced by a superheater using heating gases of high temperature. Superheaters utilizing the ordinary waste gases cannot produce a material degree of superheat.

(18) Superheaters exposed to gases of high temperature must be provided with means for shutting off the flow of the gases when the engine is standing or floating and especially so while the blower is put on.

(19) Fire-box superheaters are the most efficient type of locomotive superheaters, but they offer serious difficulties in the protection of the superheater parts exposed to the direct heat of the fire.

(20) Superheaters which use the ordinary boiler flues for a part of their length for superheating purposes have shown serious defects in practice.

(21) Smoke-tube superheaters using ordinary field tubes are neither efficient nor economical, as the saturated steam flowing in the inner tube cools the superheated steam flowing in the outer one. On account of the difficulty in keeping the tubes clean and the small advantage gained, field tube superheaters in locomotives have been practically given up in America.

(22) Smoke-tube superheaters using circular return-tubes are at present the most efficient and practicable superheaters for locomotives.

(23) The efficiency and the steaming capacity of a locomotive boiler are materially increased by the application of a well-proportioned smoke-tube superheater.

(24) The principal advantages of the compound arrangement in saturated steam locomotives lie in the fact that it allows of the use of higher boiler pressures than in simple engines, and that it reduces the losses due to condensation in the cylinders. Both advantages are the less pronounced the higher the speed of the engine, and they practically disappear for very high speeds and early cut offs.

(25) Superheated steam can be applied to compound locomotives in three different ways:—(1) by "initially" superheating the high-pressure steam; (2) by the use of a "two-stage"; or (3) by the use of an "intermediate" superheater.

The first case is the most advantageous form. Approximately 50 deg. F. less superheat than that required in the case of a simple engine is sufficient to avoid all losses by condensation in the compound locomotive. Compared with the highly superheated steam simple locomotive, a small saving in coal, and a somewhat increased boiler capacity can be obtained.

(26) It is still an open question, and it depends very largely on the service to be done, whether the above-mentioned advantages of superheated steam compound locomotives are not more than counterbalanced by the practical difficulties inherent to compound working, especially as regards high boiler pressures and lack of adaptability of the engine.

In the author's opinion, the express engine of the future will be of the four-cylinder simple type, using highly superheated steam, and working with a moderate boiler pressure.

COAL VALUES.

In an address before the convention of smoke inspectors at Cleveland, D. T. Randall, engineer in charge of tests at the fuel testing plant of the United States Geological Survey, stated that a study of the fuel values of coals burned has shown that their value depends almost entirely on the number of heat units which it contains as determined by a calorimeter, these relative values being influenced somewhat by the amount and character of volatile matter and of ash present in the coal. This information has strengthened the position of the government engineers who desire to purchase coal on a specification which has for its basis of payment the British thermal units and ash in the coal.

For the coming year a very large part of the coal purchased for the government will be paid for according to its value as determined in the government chemical laboratories. One of the largest purchases under this form of contract is for use on the isthmus of Panama and calls for the delivery of 400,000 tons within the year.

Investigations of the washing and coking tests of coals have also shown the possibilities of utilizing poorer grades of coal than are commonly used, and point to a very considerable saving in our fuel supply. The experiments on the briquetting of coal have shown that the slack coal which is otherwise difficult to utilize, may be made into artificial lumps and used with high efficiency in power plants or for locomotive use.

A study of the furnace conditions in connection with the

boiler tests will show the influence of different methods of burning coal with relation to the reduction of smoke. These tests have demonstrated the possibility of burning certain kinds of coal efficiently without smoke in an ordinary furnace. They have pointed to possibilities of modifying furnaces so that practically all fuels may be burned without smoke under favorable conditions. Some bulletins have already been issued on this work, but those which deal directly with the smoke problem are now in course of preparation. The tests made at the producer gas plant have shown that it is possible to burn almost any grade of coal with the very highest efficiency and absolutely without smoke. Bituminous coals having as high as 45 per cent. of ash, lignites and peats, which are considered low grades of fuel for boiler furnaces, have been very successfully burned in the producer, generating gas for the development of power in a gas engine. The low-grade lignites of North Dakota developed as much power per pound in the gas producer as do the very best West Virginia bituminous coals, when utilized in a steam boiler with a simple non-condensing engine, such as is usually installed in manufacturing plants.

The results of these investigations will have an important bearing on the question of smoke prevention both directly and indirectly, but the Government is investigating the possibilities only from the engineering and not at all from the legal standpoint.

A TEST OF LARGE REINFORCED CONCRETE BEAMS.

In connection with the Grand Crossing, Chicago, track elevation work, the Illinois Central will use for its subway bridges large reinforced concrete floor slabs similar in design to those used by the Chicago, Burlington & Quincy in its Sixteenth street track elevation work in the same city, described in the *Railroad Gazette* May 10, 1907. A large number of the slabs were made up by the Illinois Central last year. Because of the magnitude and importance of the work in which they are to be used, and the desirability of determining the properties of large beams made under practical conditions, it was decided to make tests of sample slabs, taken from among those that had been made up. The co-operation of the Engineering Experiment Station of the University of Illinois was secured, and the tests were made in Chicago under the direction of Prof. Arthur N. Talbot of the university. Following is his report of the tests:

The test here described will be of interest to engineers because the reinforced concrete beams were chosen almost at random from a large number of beams made up for use in a railroad structure and thus may be considered to be representative of actual conditions of construction, and because the tests give a comparison of the efficacy of two methods of placing the reinforcement to resist diagonal tension or so-called shear failures. The beams were perhaps the largest reinforced concrete beams yet tested, and the testing apparatus used and the method of making the test involved some novel features. The beams were tested in the yards of the Illinois Central Railroad at Twenty-seventh street, Chicago, close to the point where they were made. They were in the form of slabs 25 ft. long, 6 ft. 3 in. wide, and 34 in. deep at the middle, and weighed about 33 tons apiece. They were built for use in the floors over the subways of the Grand Crossing track elevation work now being done. The slabs span the distance from the curb to the center of the street pavement, making a floor over the street upon which the ballast is spread and the track laid for the eight-track railroad.

The slabs were built by the railroad company's force. The concrete was composed of 1 part cement, 2 parts sand, and 5 parts unscreened limestone. The concrete was machine mixed and was made wet so that little or no tamping was required. "Owl" Portland cement was used. Tests of the cement gave a tensile strength of 822 lbs. per sq. in. for the seven-day neat test; 95.2 per cent. passed the No. 100 sieve.

The longitudinal reinforcement was 1-in. corrugated bars. Tests made by Robert W. Hunt & Co. on bars selected from those used on the work showed an elastic limit of 52,000 lbs. per sq. in. Twenty-nine of the 1-in. bars were used in the width of 6 ft. 3 in., the spacing being made $2\frac{1}{2}$ in. center to center; and as the distance from top of slab to center of bars at the middle of the beam length was $30\frac{1}{2}$ in. the reinforcement was about 1.25 per cent. Two forms of bending up the bars at the ends were used. In No. 70, which was the last slab made in this way, the bars were bent up at an angle of about 45 deg. rather close to the end, the bend for one-fourth of them starting at about 2 ft. from the end, for another fourth at 3 ft., for another fourth at 4 ft., while the remaining bars were straight throughout the length of the slab. No stirrups were used in No. 70. In the slabs made after No. 70 (including No. 71 and No. 72, which were tested) stirrups were used and the bars were bent up farther back from the end and less abruptly. In one-fourth of the bars the inclination started at a point 6 ft. from the end, in one-fourth 4 ft. from the end, and in one-fourth 2 ft. from the end, while as before the remaining bars were horizontal. In these slabs U-shaped stirrups made of $\frac{1}{2}$ -in. corrugated bars were placed vertically at distances of $2\frac{1}{2}$ ft., 4 ft., $5\frac{1}{2}$ ft. and 7 ft. from the ends of the slabs. Each stirrup passed under and included five reinforcing bars and reached nearly to the top of the slab. In addition to the bottom reinforcing bars, four $\frac{1}{2}$ -in. cup bars were placed longitudinally 3 in. from the top of the slab; and transversely across the slab 2 in. below the top were $12\frac{1}{2}$ in. and six 1-in. bars, while transversely across the bottom longitudinal reinforcement were 21 $\frac{1}{2}$ -in. bars. At the middle of the width of the slab and at 2 ft. 6 in. from either end heavy steel stirrups were inserted; these were used to fasten the lifting device to when the slabs were lifted and moved. The slabs tested were made Oct. 7 and 8, 1907. No. 70 was tested April 15, and No. 72 April 28, 1908. In the meantime they were left just where made and were exposed to the weather. Although they were over six months old, the setting of the concrete during the winter weather must have been slow, and the conditions would be less favorable than is usual for 90-day test beams.

The illustrations show so well the form of the testing machine that we have omitted this part of Mr. Talbot's description, since the results presumably have broader interest than the methods employed. In general, it may be said that the action of the jacks, the uniformity of the results and other circumstances indicate that the testing apparatus was trustworthy within the limits which may be considered necessary for the purposes of the test.

The following are notes of the test of No. 70. It should be borne in mind that the condition of the surface of the slab was not favorable to the early discovery of cracks.

25,000 lbs.	This load is assumed to be weight of testing apparatus, men and initial tension on rods.
333,000 "	First tension crack at center of top slab.
364,000 "	Small tension crack at north load of top slab.
432,000 "	Second tension crack near center of top slab.
468,000 "	First diagonal crack outside north load.
496,000 "	Numerous small tension cracks.
593,000 "	First diagonal crack lengthening rapidly and becoming more marked.
626,000 "	Cracking along the steel at south end.
693,000 "	In the interval after 488,000 lbs. other diagonal cracks appeared near the first.
734,000 "	First diagonal crack opening wide.
801,000 "	Failed suddenly along first diagonal crack, which reached top just inside the load point.

The results of the test of No. 72 are given in the table. The calculated stress in the steel is based on the formula for resisting moment, $0.87 Afd$, where A is the area of the reinforcing bars, f is the stress, and d is the distance from top of slab to center of bars, called here $30\frac{1}{2}$ in. The surfaces of No. 71 and No. 72 were coated with whitewash and marked off in 6-in. squares, and the position of the cracks at the different loads was noted and traced in pencil as the test progressed. The cracks were afterward painted with black paint and hence appear greatly magnified in the photographs. The numbers on the photograph mark the limit of the cracks

at the applied load given for the same number in the table.

Results of Test of No. 72.

Ref. No.	Applied load, lbs.	Average deflection, in.	Stress in steel,* (lbs. per sq. in.)		Remarks.
			From deformation.	From bending moment.	
0.	25,000	0.00	.....	1,500	This load of 25,000 lbs. is assumed as weight of testing apparatus and men and initial tension of rods.†
1.	45,000	....	.....	2,700	
2.	67,000	0.01	.....	300	
3.	103,000	0.02	1,200	6,300	
4.	131,000	0.03	2,100	8,000	
5.	159,000	0.05	3,600	9,700	Short tension crack.‡
6.	189,000	0.10	6,000	11,500	Numerous tension cracks.
7.	220,000	0.11	7,500	13,400	Vertical cracks just outside load points.
8.	253,000	0.13	10,500	15,300	
9.	285,000	0.17	14,700	17,400	
10.	317,000	0.18	17,700	19,300	More cracks outside of load points.
11.	350,000	0.24	20,100	21,400	
12.	382,000	0.28	23,100	23,300	
13.	414,000	0.31	25,800	25,300	
14.	447,000	0.36	27,900	27,300	
15.	480,000	0.40	29,400	29,300	
16.	514,000	0.43	31,800	31,400	
17.	578,000	0.52	36,900	35,300	
18.	643,000	0.61	42,000	39,300	
19.	704,000	0.70	47,700	42,900	
20.	780,000	0.88	61,200	47,700	
21.	811,000	1.32	108,000	49,600	Tension cracks opening wide
22.	840,000	1.60	.....	.....	Max. load; tension failure.

*Add 2,800 lbs. per sq. in. for stress due to weight of slab.

†After jacks were in operation all but 9,000 lbs. was indicated by readings of jacks. The "Average Extensometer Readings" are for a gage distance of 50 in.

‡Just inside south load point.

These numbers permit the growth of the cracks to be traced. The smooth white surface permitted the cracks to be seen while very small, and the tension cracks in No. 72 were noted at much lower loads than in No. 70, which had not been whitewashed. The measurements on the lower slab, No. 71, in the second test were made with a type of instrument which is not entirely suitable for this form of test, and as the results are somewhat irregular they are not given here. The readings of the vertical extensometers showed a marked increase in the later stages of the test and will be referred to in the discussion of diagonal failure.

As is usual in such tests, minute cracks become visible in

yield point, these cracks closed up upon the release of the load to such an extent as to be scarcely detectable. In No. 70 (not whitewashed) the first tension crack was noted at an applied load of 333,000 lbs. and numerous tension cracks

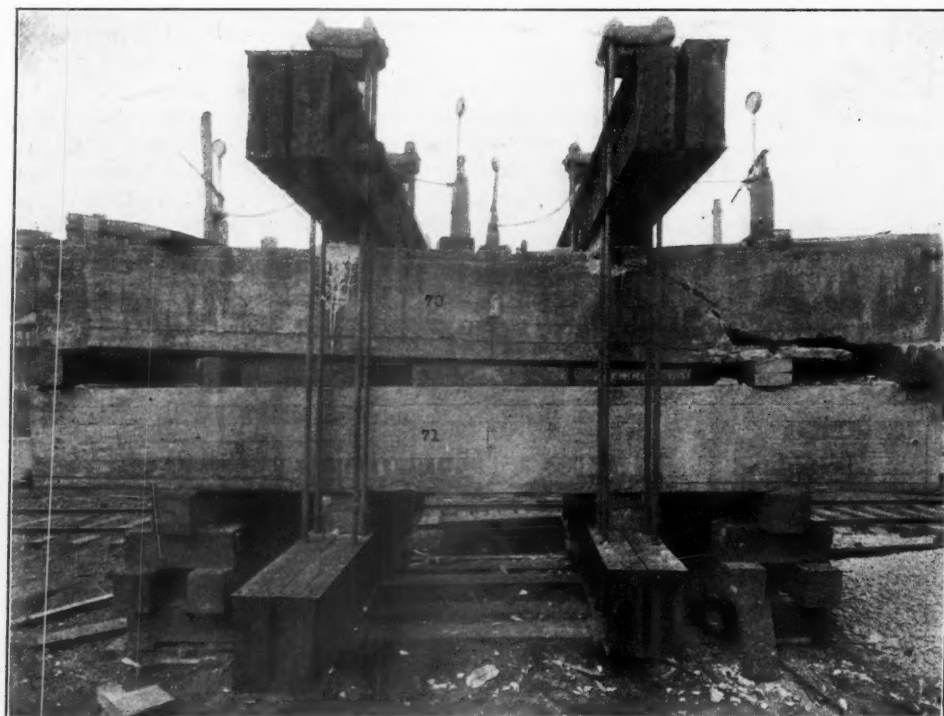


Testing Machine in Position.

at 496,000 lbs. In No. 72 (whitewashed surfaces), the first tension crack was noted at 159,000 lbs. and numerous tension cracks at 189,000 lbs. It will be seen from the photographs that some of these minute cracks reached points 12 in. from

the top of the slab before the reinforcement was stressed to its yield point. Even when they had thus grown their size at the bottom was minute.

Outside the load points (i.e., in the outer thirds of the beam length) diagonal cracks appeared, frequently forming from the top of a vertical crack already visible and extending diagonally upward and downward at the same time. In No. 70 the first diagonal crack was visible at an applied load of 468,000 lbs., and in No. 72 cracks became distinctly diagonal at 447,000 lbs. The diagonal cracks developed with the addition of load, but the form of this development was not the same in No. 70 and in No. 72. In No. 70, the slab without stirrups and having the bars bent up abruptly near the ends, one main diagonal crack formed outside each load point making an angle of about 35 deg. with the horizontal. While a few others became visible, these main cracks enlarged and the final failure of the slab was along one of



Failure of No. 70 by Diagonal Tension.

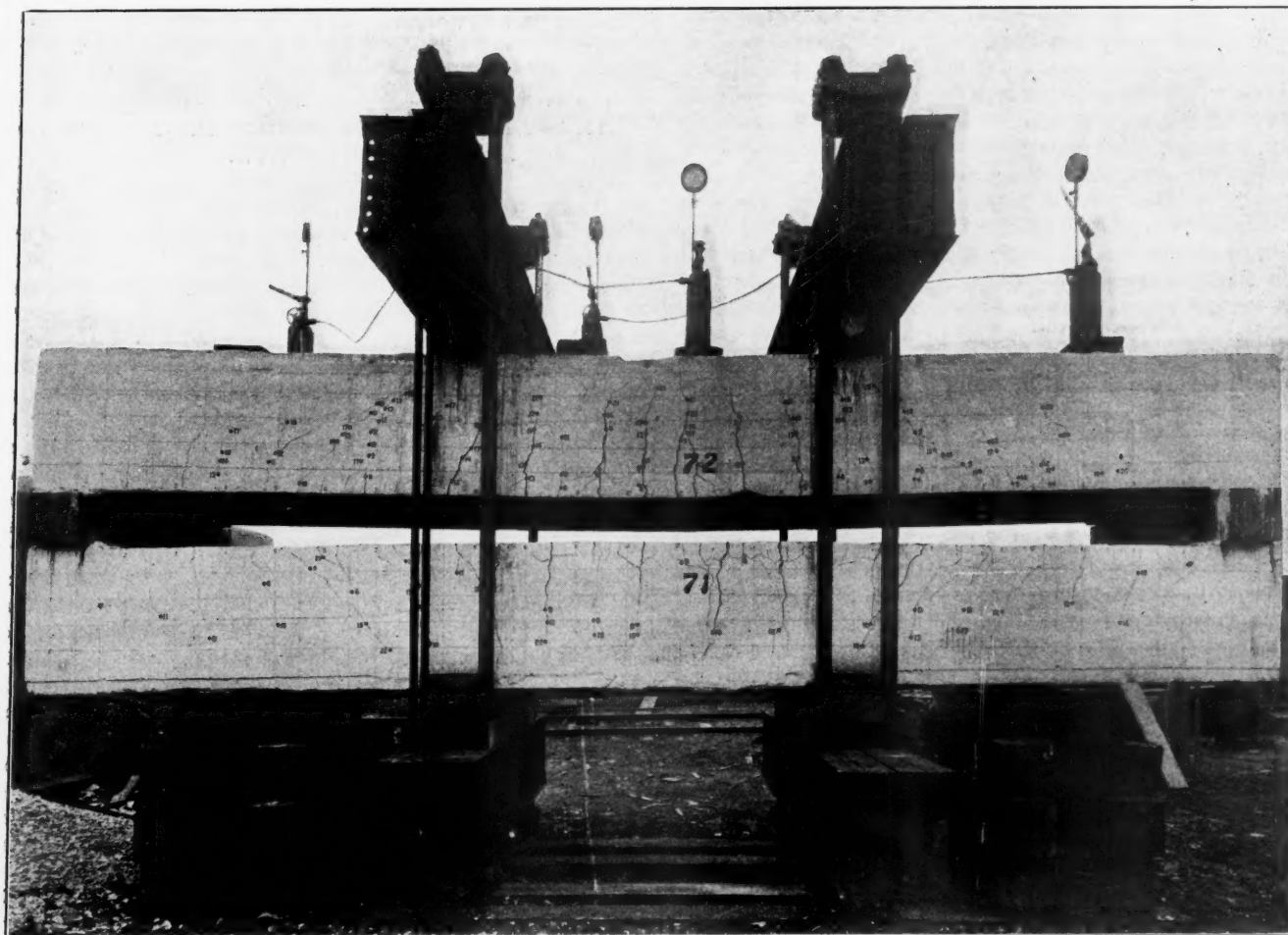
the concrete on the tension side of the beam between the load points as the load was applied and on the outside of the load points at higher loads. These cracks grew in height and became more marked as the load was increased. In the first test (No. 70 and No. 71 together), in which the beams did not fail by the reinforcing steel stretching up to the

them. In No. 72 (whitewashed surfaces) several marked diagonal cracks had extended for some distance at the load of 480,000 lbs. Some of these finally extended to within 12 in. of the top face of the slab, but they remained small and fine and were well distributed over the beam.

The manner of failure of No. 70 and No. 72 was quite dif-

ferent. Although it is evident from calculations that the steel of the reinforcing bars in No. 70 had nearly reached the yield point, there was no evidence of this in the appearance and action of the beam at the time of failure. At a load of 593,000 lbs. the main diagonal crack outside of one load point was seen to be extending rapidly and at 734,000 lbs. it was opening wide. It was evident for some time that the beam was on the verge of total failure. Finally it failed suddenly by diagonal tension (so-called shear failure) at an applied load of 801,000 lbs., the diagonal crack having suddenly extended to the top of the slab and opened wide. At the same time the horizontal crack which had formed along the reinforcing bar (by the action of vertical tension) lengthened and the bar pulled away from the concrete above. The characteristic of the test was the formation of main diagonal cracks at either end and the final sudden failure of the beam by

not have held long, and the maximum load applied held but momentarily. After the maximum load was reached, the load fell off as the deflection was increased. The characteristic of the test of No. 72 was slow failure by tension of the steel, without sign of compression failure and without sign of impending failure by diagonal tension. The effectiveness of the stirrups and the bending of the bars at the ends is made evident by the test. This is the more important as the diagonal tension failure may give little warning and may develop with repetitions of lower loads. It may be noted that on the next day the test was continued until there was a deflection in No. 72 of $3\frac{1}{2}$ in., and the load applied was nearly 800,000 lbs. Upon release of load there was a recovery of 1 in. in the deflection. At this time the stretch of the steel and the consequent concentration of the compressive stress were so much that there was considerable crushing of the concrete.



Tension Cracks in Beams 71 and 72 at Maximum Load.

diagonal tension. In No. 72 the presence of the stirrups and the changed position of the reinforcing bars at the ends were sufficient to resist the diagonal tension developed. Although the diagonal cracks were numerous and although some of them finally extended to within 12 in. of the top face of the slab, they remained small and fine and were well distributed. They lacked the growth and concentration which are apparent in failures by diagonal tension in beams without metallic web reinforcement. The tension cracks in the middle third of the beam extended upward as the load was increased and at 811,000 lbs. nine of these were visible to within 12 in. of the top of the slab. At this load the tension cracks were opening wide, indicating that the yield point of the reinforcing steel had been passed. The maximum load applied was 840,000 lbs., but above 800,000 lbs. the deflection increased rapidly. It seems evident that a load of 811,000 lbs. would

Slab No. 71, which was used as the lower beam in both tests, seems not to have suffered from the first test, the cracks closing up upon release of load. In the second test the tension cracks opened up and at the maximum load there was evidence of the steel being stretched beyond the yield point. It should be noted that on account of its inverted position and the location of the supports the bending moment developed in the lower beam was somewhat smaller than that in the upper beam. There was no sign of impending failure by diagonal tension.

The proportionate depth of the neutral axis for the amount of reinforcement here used, based upon ordinary assumptions, would be in the neighborhood of 0.43 to 0.47. Calculations from the observed deformations give a position which seems abnormally high, averaging during the later stages of the test about 0.34 of the distance from the top of the slab to the

center of the reinforcing bars. An examination of the original data suggests that there was slip in the top extensometers and that the neutral axis must have been lower than shown by these results. The vertical position of the line for top fiber compression given in the diagram between loads of 220,000 lbs. and 320,000 lbs. (showing little increase in the compression) shows where the trouble lies. It should be noted that with such slip of the upper extensometer the real compressive deformation would be greater than that given in the diagram and that the real tensile deformation would be somewhat less.

The vertical shearing stress in the concrete at the breaking load of No. 70, calculated by the formula $v = \frac{V}{bd'}$, (where V

is the total vertical shear at the point where the crack begins, including the shear due to weight of slab, and b is the width of the slab, and d' is the distance from the center of the reinforcing bars to the center of gravity of the compression area of the concrete (called here 0.87 of the depth to center of reinforcing bars), is 209 lbs. per sq. in. The vertical shearing stress so calculated may be used as a means of comparison of the resistance to diagonal tension; 209 lbs. per sq. in. is a high value for a beam without stirrups and having bars bent up abruptly at the end, and shows a good quality of concrete. The value of v for the applied load of 468,000 lbs., where the first diagonal crack was noted, is 125 lbs. per sq. in., and for the applied load of 593,000 lbs., where the main diagonal crack was seen to be lengthening rapidly and becoming more marked, was 156 lbs. per sq. in. In No. 72 the value of the vertical shearing stress, v , at the maximum load applied is 220 lbs. per sq. in. As there was no sign of impending failure and as the diagonal cracks closed up after the failure of the beam, it is seen that the provision against failure by diagonal tension was very satisfactory. At the load of 447,000 lbs.—giving a vertical shearing stress of 120 lbs. per sq. in.—there was a marked increase in the reading of the vertical extensometer at one end of the beam and an evident development of the diagonal crack. A similar development was noted with the extensometer at the other end at a load of 514,000 lbs. Above these loads the readings of the vertical extensometers increased rapidly.

The tension in the reinforcing bars at the middle of No. 70, calculated by the usual methods, and including the effect of the weight of the beam, was 51,700 lbs. per sq. in. at the maximum applied load of 801,000 lbs. As the tension cracks in the concrete closed up after the failure of the beam it would seem that the steel had not been stretched beyond its yield point. In No. 72 the calculated tension in the reinforcing bars, including the effect of the weight of the slab, was 54,000 lbs. per sq. in. for the maximum applied load of 840,000 lbs. For the applied load of 811,000 lbs., where the yield point evidently had been passed, the calculated tension is 52,300 lbs. per sq. in. These values check up with the yield point of the material within the limits of variation of such material.

The compression in the upper fiber calculated by the ordinary methods runs up to a high figure, as is usual in tests of beams having a considerable amount of reinforcement. Assuming the neutral axis to be at 0.43 of the depth to the reinforcing bars, and using the ordinary straight-line formula, the compressive stress in No. 72 at the maximum load was 3,190 lbs. per sq. in. Using the parabolic formula and considering that the compressive deformation is one-half of the ultimate compressive deformation of concrete, the calculated stress is 2,870 lbs. per sq. in. Even at this high calculated stress there was no sign of compression failure until after the steel had stretched beyond its yield point. Comparing the deformation developed with that of other tests it seems probable that the beam would have taken at least one-third more compressive stress before failure in compression at first loading. Of course, repetitive loading at any such high load might soon have injured the beam.

The tests showed that the concrete was of excellent quality and that the slabs acted similarly to high-grade test beams made and tested in laboratories. The uniformity and regularity of these large beams are shown in various ways in the tests. As these slabs may be presumed to be fairly representative of the slabs fabricated for the work, the tests will add confidence in the quality and soundness of the reinforced concrete used in this work. The action of the concrete in compression under the high stresses developed was quite satisfactory. The tests show the effectiveness of stirrups and of the method used in bending up bars at the end in resisting diagonal tension. As diagonal tension weakness is particularly undesirable, because of possibility of sudden failure and of injury with repeated application of the load and because of the difficulty of detecting incipient failures when the sides of the beam are not available for inspection, ample safety against these stresses is important. Failures by tension of the steel and by compression of the concrete give warnings through abnormal deflections and in other ways and are less likely to lead to serious results.

THE ABSORPTION MACHINE IN RAILROAD REFRIGERATION.

BY JOSEPH H. HART, PH.D.

Mechanical refrigeration is daily becoming a more pronounced factor in the transportation of perishable products. This latter field is practically the one development in which mechanical refrigeration has not progressed until recently. In almost every department of cold storage and in many additional developments as well, mechanical refrigeration has distanced its natural competitor, ice, not only from a mechanical efficiency point of view, but from the standpoint of cleanliness, reliability and convenience. The reason that the development has not extended into railroad work with the same ease and rapidity with which its progress in other lines has been marked is due to various limitations and special difficulties which arise in this field.

In the first place mechanical refrigeration in railroad transportation has a greater variety of duties to perform than in almost any other application. It is much worse in this regard than the ordinary cold storage plant since the latter is to-day becoming largely a specialized business and many cold storage systems refuse to handle any other material than that which falls in a single class of refrigeration. Products for refrigeration are divided into classes according to the type of refrigeration required and the quantity. Thus, there is a primary classification into mild, medium and sharp refrigeration. Bananas and many fruits are kept best at a temperature from 60 to 65 deg. Fahr. Thus any temperature above 50 deg. and below climatic conditions constitutes what is known as mild refrigeration. Meats and many fruits are maintained best at a temperature from 35 deg. to 46 deg. Fahr., and anything between 50 deg. and the freezing point of water is known as medium refrigeration. Fish and many meats as well are often frozen solid or frozen in what is equivalent to cakes of ice, and these are preserved best at a temperature considerably below the freezing point and this class of products falls under the type of extreme or sharp refrigeration. The problem is complicated by this development in transportation work, since the various types of refrigeration here mentioned are best produced by different types or at least modifications of various types of refrigerating machines.

Again there is a classification in regard to bulk. Many cold storage plants refuse merchandise for cold storage of special products when these are in abnormally large packages. This limitation should exist in railroad work in this field, but is not present to anywhere near the extent that it exists in the cold storage field, hence the problem is further complicated by this feature. In addition, many products are fur-

nished to the railroad for transportation at abnormally high temperatures, that is, they have not been in cold storage before presentation for transportation. Hence the duty of the railroad becomes not only a transportation problem in refrigeration involving the maintenance of low temperatures, but the production of them as well in the various materials, thus constituting a cold storage plant addition to the ordinary railroad transportation problem. This latter feature is beginning to receive attention to-day in a separation of the two different duties with preliminary cooling or refrigeration of the material before packing for transportation. Such plants are known as pre-cooling or fore-cooling plants and are coming into existence under private ownership and have been developed by the railroads in California and in a number of southern states. Their necessity can be well gaged from the fact that many cargoes of fruit, especially oranges, packed for shipment in California, will often arrive in New York before the pre-cooling or initial preparation for cold storage has been completed in the ordinary refrigerator car.

From the preceding it can be readily seen that the application of mechanical refrigeration in railroad work is a much more complicated problem than any of the developments previously attempted by that device. The separation of the duty of cold storage plant and transportation duty is a step in the right direction and will tend to simplify the problem at hand. As long, however, as railroads persist in regarding mechanical refrigeration as a unit without division according to classification they will encounter the same difficulty present in cold storage plants and pipe line installations where all business presented is accepted independent of the character or mechanical difficulties involved.

Another reason for the lack of development in mechanical refrigeration in railroad work is undoubtedly due to the specially advantageous position occupied by natural ice in this field. The railroad traversing a large section of territory can generally get its natural ice to the best advantage from a first cost viewpoint and possesses opportunities of cutting and storing its own supply in various localities along the right of way often not available to private individuals. When the further fact is considered that the railroad generally regards the transportation of its own supply of ice as nominal and makes no entry in regard to this feature of the cost of production, it is natural that the natural product should occupy a much more advantageous position in this development in comparison to its competitor in the mechanical field. However, the fact remains that even under ordinary conditions of market limitation and small season for operation, the mechanical plant can produce ice considerably cheaper than the natural ice can be harvested and stored and shipped to point of utilization. Very seldom can ice be cut, stored and shipped to market for less than \$1 a ton when all fixed charges are considered and operating expenses as well. Very many refrigerating plants on the other hand produce ice for as low a cost as 50 cents a ton and do this with the further limitation of limited season and a restricted market and comparatively high administrative expense. When it is further considered that in railroad work the administrative factor would be of minor importance the selling cost would be practically nil and that the time of operation for a plant could be extended with complete satisfaction throughout the entire twelve months at maximum capacity, the excess supply being sent to other points as needed, with no further loss than that now existing in the transportation of this product, the special advantages of mechanical refrigeration in railroad work become partially apparent. Again, the modern ice making plant is limited in its production of ice by the necessity of making a marketable product, that is, the ice must be clear or transparent, pure and of uniform size, frozen in a special way, with capabilities of cleavage in various directions easily. These limitations are such that unless the plate system of ice making is used, distilled water is a necessity and the capacity of a modern ice

making machine is limited by the capacity of the boiler and the supply of distilled water rather than by the size of the refrigerating machine itself. The production of the blocks of ice is a slow process, the latter half of the freezing of each block taking fully 70 per cent. of the time of operation. None of these limitations is present in the production of ice available for refrigerating purposes in transportation, the water need not be clear, and almost any source of supply is directly available for this purpose, thus further limiting the necessity of purchase of a suitable supply often present in the commercial world. Further, the blocks need not be frozen entirely and they can be frozen with much lower temperatures and with much greater rapidity, thus increasing the capacity in ice production of a given installation fully 50 per cent. with a corresponding diminution in the fixed charges, which diminution can be much further augmented by the fact that there need be no limitation in regard to time of operation of plant with seasons. Very similar conditions hold in a special development, namely, that of ice cream manufacture, in regard to the character of the ice which can be utilized, and it is a known fact that in this field a saving of fully 20 per cent. in the cost of production of the ice over that existing in other applications is actually possible.

Now, there are two types of refrigerating machines available for ice making possessing great reliability and well known and practically standard in type. Both of these types utilize ammonia for production of refrigeration, since the latter liquid is by long odds the most efficient agent for the conveyance of the heat in refrigerating processes and occupies a place analogous to water in power production. These two types are known respectively as the ammonia compression machine and the ammonia absorption type. Ammonia liquid needs no machinery to produce mechanical refrigeration. Under normal atmospheric conditions it possesses a boiling point of $28\frac{1}{2}$ deg. Fahr. below zero, and if exposed in an open barrel will boil away spontaneously, absorbing its own heat of vaporization from surrounding bodies and the barrel under these circumstances will become rapidly covered with a layer of ice from the moisture in the atmosphere which condenses on it. The machinery in refrigerating plants is used exclusively for regenerative purposes, since ammonia liquid is not a natural product and is obtainable only as the result of extensive manufacture and at considerable cost. In the compression type the ammonia gas is drawn off from the cooling coils, which contain the liquid ammonia and in which the refrigeration is produced, into a compressor where it is compressed to about 180 lbs. gage pressure. At this pressure the boiling point of liquid ammonia is raised so much that the gas can be liquified by cooling with cold water alone, and by the relief of the pressure above this liquid to the suction pressure on the machine, the boiling point is again lowered and the refrigeration continued. Thus, the refrigeration machine is in many respects analogous to the operation of a pump and is often spoken of as a heat pump, the heat absorbed in the cooling coils being taken by the ammonia to a higher temperature and dumped out through the condenser into cold water.

The absorption system, on the other hand, utilizes the absorptive power of cold water, or weak aqua ammonia, for ammonia gas and the loss of this power with rise in temperature to produce the same effect, namely, the regeneration of the liquid ammonia from the ammonia gas. Steam coils traverse a generator constructed in many respects like the steam boiler and filled with strong aqua ammonia from which, on the application of heat, ammonia gas is evolved and condensed by means of cold water under pressure. The aqua ammonia is then cooled and absorbs vapor from the boiling ammonia liquid and the process is made continuous by making two closed cycles of the materials involved in the process. Now the absorption machine, while the first practical refrigerating machine in existence, has, until quite recently, been considered a very inefficient device. Large quantities of steam are

required to produce the ammonia gas under pressure and the heat waste through the aqua ammonia was enormous, since it, after heating, had to be cooled for the further performance of its duty. Again, steam often passed over into the condensing coils along with the ammonia gas and was condensed there under the action of the cold water and the water of condensation then present absorbed large quantities of the liquid ammonia at this point, rendering it unavailable for utilization in refrigeration. The advent of the compression type, with its comparatively high efficiency, for a time practically put the absorption machine out of business and predictions were frequently made a decade ago that the absorption machine was an obsolete type in commercial development. However, within the last few years the absorption machine has been making rapid strides and is to-day not only on a par with the compression type, but in many respects and under special circumstances, much superior, the size of the advantage of this type being only roughly estimated in many cases up to the present time, but known to be enormous under special conditions. The reason for this development as shown is twofold. The absorption type occupied an isolated position in the engineering field and the modern movement of increased efficiency occurred at a later date in this field than in other departments. It has been shown conclusively that the efficiency of the absorption type is a factor dependent almost absolutely upon the design and operation of the machine. Both the compression and absorption types can operate with absolutely no production of refrigeration if wrongly designed or operated. With a scientifically constructed absorption plant the mechanical efficiency of the two plants is not only reversed, but this reversal is extended to a remarkable extent. The absorption type utilizes the heat in the steam rather than the work available from it, and while it actually uses several times as much heat as the compression type, when quantities of steam consumption are considered, it is much superior. Again, development in design in the absorption machine has been such that the latter can now be operated by the heat in exhaust steam, the exhaust steam from a compression plant being capable of operating an absorption system of equal capacity and according to some authorities 50 per cent. greater. The availability of exhaust steam in this field is well recognized. However, this advance is limited by present conditions due to the existence in operation of many absorption plants of old design and low efficiency incapable of modification according to new ideas, and the further fact that some of these old types of absorption machines are still being manufactured.

Not only is the absorption type infinitely superior from an efficiency point of view and from the fact that it can utilize exhaust steam wherever the latter is available, whether obtainable from the exhaust of locomotive repair shops, or any ordinary power producer, but it possesses further remarkable advantages in special types of refrigeration. Thus the temperature obtainance in a refrigerating plant is a direct function of the pressure of the ammonia gas above the boiling liquid. Ordinary compression machines are rated per ton refrigerating capacity on a back or suction pressure of 15 lbs. gage pressure and this means that the temperature of the boiling ammonia is about 0 deg. Fahr. Various limitations in regard to the utilization of this refrigeration, purely of a mechanical and commercial character, further reduce the available temperature so that the average temperature of a brine tank for ice making purposes is from 16 deg. to 18 deg. Fahr. Any further reduction of this temperature is obtainable only by a further diminution in the suction pressure of the gas and a corresponding decrease in the capacity of the compressor for ammonia gas per stroke of the engine. The refrigeration produced, other influences being equal, is in direct proportion to the speed and capacity of the compressor. Hence, extreme refrigeration is produced with a corresponding decrease in efficiency of operation, the latter being inversely proportional to the temperature desired. The absorption ma-

chine, on the other hand, can operate on a suction pressure equal to that of the atmosphere, or even a partial vacuum, with an efficiency even greater than that under normal compression conditions and the speed of operation even increases with lowering of the temperature required. Thus this type produces extreme refrigeration with even an increase in efficiency and brine tanks for ice making purposes if cooled by an absorption plant are generally carried about 0 deg. Fahr. or even 10 deg. below. Thus, the absorption type possesses advantages in regard to the quantity of ice available from a given installation, since this latter is inversely proportional to the time required for its manufacture. Radiation losses and operating expenses are cut down, with a further increase in efficiency, and ammonia compression plants are to-day changing into the absorption system or making additions of this latter type, the first being readily accomplished on account of the fact that the compressor can be used for air compression, which air, in turn, is used for an air lift pump for water for condensing purposes, and the exhaust from this compressor used to operate the refrigerating machine. This modification of the compression type into an absorption system is generally accompanied by an increase in capacity of from 20 to 40 per cent., since an ordinary ice making plant of the compression type uses about 35 per cent. of its steam consumption for auxiliary purposes.

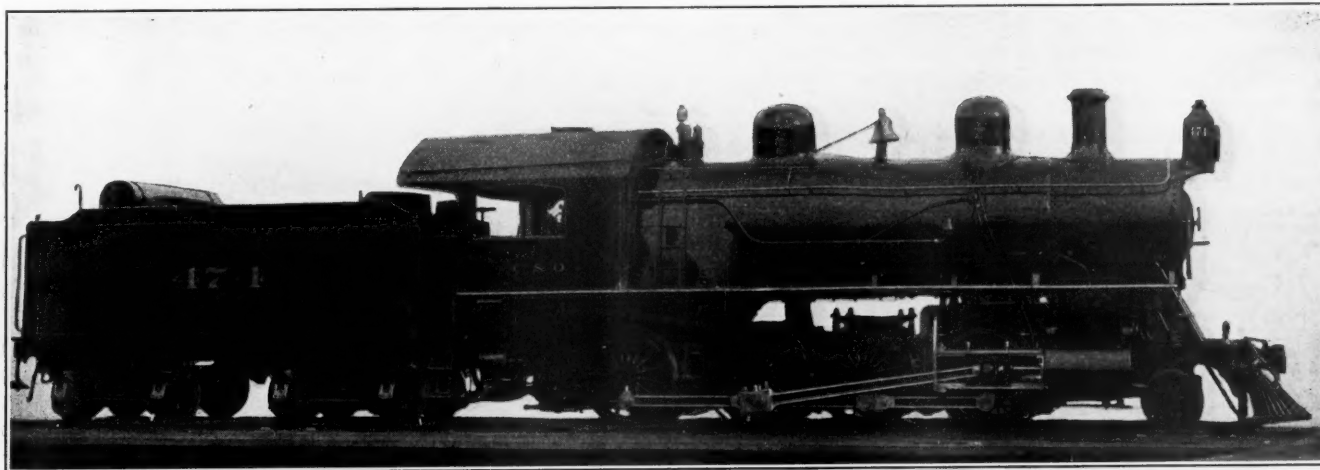
Thus, undoubtedly the absorption system possesses remarkable advantages in the production of refrigeration over the other type. All classes of refrigeration can be carried and the refrigeration produced more quickly in pre-cooling stations and more efficiently as well. The rapidity with which ice can be made in small blocks by an absorption plant is remarkable, especially when there exist no limitations in regard to the character or purity of the ice or conditions in regard to size and other matters. In railroad work the absorption plant can be installed at suitable points to operate from the exhaust steam of the average railroad repair shop. Ice can be manufactured for transportation in the ordinary refrigerator car and a pre-cooling station is at once at hand and readily available as well. Further, the possibilities of using the mechanical refrigeration in the cars directly without the intermittent use of ice becomes at once a possibility. Cold brine possesses a large heat capacity and when cooled to extreme temperatures can be frozen if desired. Thus, a plant capable of supplying cold brine in place of ice to the ordinary refrigerator cars would furnish a material possessing equivalent refrigerating capacity with much greater rapidity of operation in pre-cooling and would occupy considerably less space without the further condition of handling and inconvenience and waste present in the utilization of ice.

Undoubtedly the absorption type will be the one ultimately to become standard in railroad construction if natural ice ever loses its present position in this field. Automatic or mechanical refrigerating cars are unavailable under present conditions and would undoubtedly operate at a much less efficiency than exists under present normal conditions. The development of large absorption plants possesses all the advantages of increased efficiency due to size of unit not present in the individual refrigerating car system and is a development along right engineering lines in this field. Its utilization of a by-product, namely, exhaust steam, is a further advantage and its reliability at present is much greater than that of the compression type. A compression plant ceases to operate if the compressor is shut down or disabled. An absorption plant, on the other hand, operates on diminished efficiency only if some of the steam tubes get out of commission, and it occupies a position in this regard analogous to that of the steam engine in comparison to the internal combustion motor. Undoubtedly the absorption system possesses advantages over its natural competitor the compression type in many fields and in no fields are these advantages much more pronounced than that of railroad refrigeration.

CONSOLIDATION LOCOMOTIVE; CHESAPEAKE & OHIO.

The locomotive used for hauling the coal trains on the Chesapeake & Ohio from the mines to Newport News is a consolidation, having 22-in. x 28-in. cylinders and weighing 163,900 lbs. on the drivers. The rated loading for these engines is 60 cars of 100,000 lbs. capacity each, and this is the train they haul in practice. On the James River division from Clifton Forge to Richmond the grade follows that of the old James River canal, which is a level with an occasional drop of a few feet at the old lock sites. The engines are,

Tractive effort x diameter of drivers	= 762.09
Heating surface	
Heating surface	= 64.50
Grate area	
Firebox heating surface	= 6.05*
Total heating surface	
Weight on drivers	= 54.21
Total heating surface	
Total weight	= 61.00
Total heating surface	
Displacement of 2 pistons, cu. ft.	= 12.32



Consolidation Locomotive; Chesapeake & Ohio.

therefore, obliged to work steam for the whole distance and some of the work is heavy because of the curves.

The engines are examples of a motive power that is in common use. The valves are of the piston type and are driven by the Stephenson motion, though two experimental engines with the Walschaerts gear are in service. In designing the valve motion, the links are brought down to about the level of the driving axles and short eccentric rods are used, with the motion carried from the link block to the rocker arm by an upwardly inclined transmission bar which is straight and passes above the second axle. The engines are built with the usual types of equalization, with yokes over the driving boxes and inverted semi-elliptic springs in between for the equalizers.

The following are some of the principal dimensions of these engines:

Cylinder, diameter	22 in.
Piston stroke	28 "
Boiler, diameter of shell	70 "
Steam pressure	200 lbs.
Firebox, length	90 in.
" width	75 "
" depth front	74 1/2 "
" depth back	61 1/2 "
" thickness, sides, back, crown	3/4 "
" thickness tubesheet	1/2 "
" water space, front	4 "
" water space, back and sides	3 1/2 "
Tubes, number	370
" diameter	2 in.
" length	14 ft. 9 "
Heating surface, firebox	183 sq. ft.
" tubes	2,840 "
" total	3,023 "
Grate area	46.87 "
Wheels, diameter, driving	56 in.
" truck	30 "
" tender	33 "
Journals, main driving	9 1/2 in. x 10 in.
" trailing driving	9 " x 10 "
" truck	5 1/2 " x 9 3/4 "
" tender	5 " x 9 "
Wheelbase, driving	17 ft.
" engine	25 ft. 3 in.
" engine and tender	54 ft. 10 1/2 in.
Weight on driving wheels	163,900 lbs.
" of engine	184,400 "
" of engine and tender	301,800 "
Tank capacity, water	6,000 gals.
Tank capacity, coal	10 tons
Tractive effort	41,140 lbs.

Weight on drivers	
Tractive effort	= 3.98
Total weight	
Tractive effort	= 4.48

Total heating surface	= 243.37
Displacement of 2 pistons	
Grate area	
Displacement of 2 pistons	= 3.80

*Per cent.

VALUATION OF RAILROAD PROPERTY.

BY HENRY FINK,

Chairman of the Board; Norfolk & Western.

II.

VALUATION IS NOT NEEDED, BECAUSE RAILROADS CANNOT AND DO NOT CHARGE EXORBITANT RATES.

One object of the valuation is to prevent railroads from charging exorbitant rates. The remedy is not needed because the evil does not exist. Existing state and federal laws regulating railroad charges, if properly enforced, afford ample protection to the shipper. But even if this were not so, railroad companies cannot charge exorbitant rates, because they would kill their business and put themselves into bankruptcy.

No private persons or corporations that are "affected with public interests" are so much affected by public prejudices that seek, and too often find expression, in ill-considered legislation, as the railroads are. For every ill, real or imaginary, a special legislative nostrum is prescribed. Thousands of railroad bills are introduced in Congress and in state legislatures. The remedies proposed are more numerous than the patent medicines which are advertised as panaceas for the ills to which the natural person is subject. Before the meeting of the last Congress it was earnestly demanded that, in order to cure the evil of rebating the Interstate Commerce Commission should be clothed with the rate-making power. The pointing out of the obvious fact that a commission-made rate can be rebated as easily as a rate made by the railroads made no impression upon the persons who demanded such legislation. Nor did the fact that the Elkins Act had been on the statute books for some years, which law, if it had been

properly enforced, would have stopped rebating long ago. At a recent session of Congress, Senator LaFollette introduced a bill providing for the official valuation of all the railroads in this country. This bill, however, did not receive the approval of the Senate Committee on Interstate Commerce. Mr. Bryan strongly advocates the valuation of railroad properties by the Interstate Commerce Commission and by the various state railroad commissions. As we have seen, President Roosevelt also advocates the valuation of the railroads by the Interstate Commerce Commission. The wild cry of "over-capitalization"* is raised in every section of the country and the physical valuation of railroad property is demanded.

To make a valuation of all the railroads would require years of labor and the expenditure of several millions of dollars. Owing to rapidly changing conditions, a new valuation would be needed before the preceding one could be completed. The question arises: what good would these valuations do? What do their advocates expect to accomplish?

One object is said to be the correction of the evil of exorbitant rates. As stated above, this remedy is not needed because the evil does not exist. It has been shown repeatedly that while the passenger rates on a certain class are somewhat higher in this country than in some of the more densely populated countries in Europe, the American freight rates are the lowest in the world.

A conclusive answer to the charge that rates have been extortionate in the past can be found in the report of the Interstate Commerce Commission to the Senate Committee on Interstate Commerce in reply to a resolution of the Senate, January 16, 1906. This report shows the work of the commission in respect to complaints, hearings, and decisions of the courts as to exorbitant and unreasonable rates, etc. It appears by an extract from this report made by Joseph Nimmo, Jr., former Chief of the Bureau of Statistics in the Treasury Department, and a well-known writer on economics, that only 15 cases involving exorbitant rates were decided by the courts from April 5, 1887, to March 1, 1905, and that only three of these cases were sustained by the courts, or on an average one case of exorbitant rates during each six years of the life of the commission up to March, 1905.

From a statement made by Walker D. Hines, in his testimony before the Senate Committee, it appears that from January 1, 1900, to January 1, 1905, the commission issued 13 orders in cases of unreasonably high rates, of which 10 were obeyed by the carriers, two were not obeyed, and one was not sustained by the court.

The Hon. Martin A. Knapp, Chairman of the Interstate Commerce Commission, declared several years ago that exorbitant rates were practically obsolete.

An inspection of the following table will show that the freight rates of American railroads have steadily and materially decreased since 1882:

Year.	Mileage operated.	Tons hauled.	Tons hauled one mile.	Av. rate per ton per mile.
1882	104,971	360,490,375	39,302,209,249	1.236 cents
1883	110,414	400,453,439	44,064,923,445	1.236 "
1884	115,704	399,074,749	44,725,207,677	1.124 "
1885	123,320	437,040,099	49,151,894,469	1.057 "
1886	125,185	452,245,254	52,802,070,529	1.042 "
1887	137,028	552,074,752	61,561,069,996	1.034 "
1888	145,387	590,857,353	65,423,005,985	.977 "
1889	157,758	539,639,583	68,727,223,146	.922 "
1890	163,597	636,541,617	76,207,047,298	.941 "
1891	168,402	675,008,323	81,073,784,121	.895 "
1892	171,563	706,555,471	88,241,050,225	.898 "
1893	176,461	745,119,482	93,588,111,833	.878 "
1894	178,708	638,186,553	80,335,104,702	.860 "
1895	180,657	696,761,171	85,227,515,891	.839 "
1896	182,776	765,891,385	95,328,360,278	.806 "
1897	184,428	741,705,946	95,139,022,225	.798 "
1898	186,396	879,006,307	114,077,576,305	.753 "
1899	189,294	959,763,583	123,667,257,153	.724 "
1900	193,343	1,101,080,238	141,599,157,270	.729 "
1901	197,237	1,089,226,440	147,077,136,040	.750 "
1902	202,471	1,209,315,787	157,289,370,053	.757 "
1903	207,977	1,304,394,323	175,221,278,993	.763 "
1904	212,577	1,309,899,165	174,522,089,577	.780 "
1905	217,017	1,427,731,905	186,463,109,510	.766 "

(The above figures, 1882 to 1888, inclusive, are from Poor's Manual for 1890. The figures, 1889 to 1905, inclusive, are from the annual Statistics of Railways in the United States, issued by the Interstate Commerce Commission.)

*See President Roosevelt's Indianapolis speech.

It will be seen that during the 23 years from 1882 to 1905, the average rate per ton per mile decreased from 1.236 cents to .766 cents, or .470, or over 38 per cent. While the average rates per ton per mile do not show actual reductions in individual rates or classes, because of the varying proportions of low-rate freights, such material reductions as have been made are necessarily reflected in the average rates.

The Interstate Commerce Commission's "Forty Years' Review of Changes in Freight Tariffs" contain over 100 tables showing the great reductions that have been made in individual rates both competitive and local.

WHAT IS A REASONABLE RETURN ON THE PROPERTY USED?

That railroad companies are entitled to a reasonable return on a fair value of the property used is but another way of saying that every laborer is worthy of his hire. The compensation of the laborer, be he one who labors with his hands, or a professional man, is determined by the value of his services to his employer.

The services of railroad corporations have a distinctive character, because they render three separate services to the public for which they make only one charge, viz.:

1. As proprietors of the railroad.
2. As transporters or common carriers.
3. As warehousemen.

The early railroad charters in England and in this country contemplated that the railroad companies furnish the roadway and throw it open as a highway for the use of the public, charging tolls for such use in the same manner in which canals and turnpikes did. If this idea could have been carried out it would have greatly simplified the matter of reasonableness of railroad charges. No one could object to paying the proprietary company such reasonable toll as might enable it to keep the road in a safe condition, and to earn a fair profit on the investment; and as this kind of property is exposed to dangers from the elements and deteriorates rapidly, no reasonable person would limit this fair return to the ordinary legal interest.

If transportation were furnished by a separate company, it would be less difficult to determine the value of the services, and a reasonable return on the capital invested. But in that case the extra-hazardous nature of such investment should also be taken into consideration in determining what is such reasonable return.

It is probable that if railroad accounts were kept more in detail with the view of ascertaining, with a closer approach to accuracy, all the factors which affect rates of transportation, the difficulties of ascertaining the reasonableness of rates under the varying conditions of performing the service would be minimized. At all events, prevailing misapprehensions on the subject might be more easily corrected.*

It has been pointed out frequently that the existing confusion in the minds of the people on the subject of railroad tariffs arises from the fact that people do not bear in mind that railroad charges are made up of three distinct services, and that a single measure cannot be applied to them.

There are hardly any two railroads in this country which were built or are operated under the same, or even similar, circumstances and conditions. Therefore a fixed rate of profit,

*The Hepburn Act provides that the Interstate Commerce Commission may prescribe the forms of any and all accounts, records and memoranda to be kept by carriers, including the accounts, records and memoranda of the movement of traffic, as well as the receipts and expenditures of moneys. This provision of such Act prohibits under heavy penalties (of not less than \$1,000 nor more than \$5,000, or imprisonment for a term of not less than one year nor more than three years, or both such fine and imprisonment) keeping any other accounts, records or memoranda than those prescribed or approved by the Commission.

While the uniformity of railroad accounts is very desirable, the unwisdom of prohibiting railroad companies from keeping ancillary accounts is apparent from the fact that the conditions as to operation and traffic are not the same on any two roads in the country, and information which may be of value to the operating officers of one railroad may be entirely valueless to those of another. It is gratifying to learn that the Interstate Commerce Commission in issuing its orders putting the law into effect has tempered this provision with common sense, by allowing railroad companies, at least until otherwise directed, to keep such ancillary accounts.

or an inflexible rule applied to all railroads, would result in injustice and unjust discrimination.

There is a great diversity in the earning capacity of different railroads—in their location, construction, gradients, alignment, density of traffic, and other important factors determining the net earnings of railroads. These factors vary within wide limits. What would be a fair return to the owners of one railroad may not be to those of another railroad, whose volume and character of traffic is materially different. Moreover, the earning capacity of railroads varies within wide limits during different periods. Hence, what may be a reasonable return during times of great prosperity might be wholly inadequate during times of business depression. Therefore, a uniform maximum rate of profit cannot be fixed by law, unless the government guarantees such profit for all time—and this, of course, cannot be done.

May not these considerations account for the fact that the courts have not established a basis for the valuation of railroads, nor fixed a percentage of profit ("reasonable return")? That this percentage cannot be justly restricted to the legal rate of interest is manifest from the fact that owing to the hazardous nature of investments in railroads, they cannot be deemed analogous to investments in commercial, industrial and other enterprises.

We know from experience that a large portion of the capital invested in railroads in this country has either been unproductive for a number of years or has proved a total loss. The traffic of railroads is fluctuating. There are long periods of depression of business, when rates have to be reduced in order to enable shippers to send their commodities to the markets, and when many railroads can barely earn their interest charges, and the stockholders can receive no dividends. It would therefore be unfair to confine shareholders to a fixed rate of profit when a revival of business enables the company to earn more than the established maximum.

Railroads cannot suspend operations during times of business depression, nor transfer their plants to other points, as manufacturers can do. Their operation is continuous; and as a large part of their operating expenses have to be incurred anyhow, regardless of the volume of business, they cannot materially reduce their operating expenses when the traffic diminishes.

Their properties are exposed to great dangers from the elements. Cloudbursts in the mountains and swollen streams frequently destroy hundreds of thousands and even millions of dollars worth of property, and necessitate a suspension of operations for days, weeks, and even months.

Railroad properties depreciate very rapidly. Some portions are from time to time rendered of little or even no value by the revision of grades and alignment, by the adoption of modern improvements in machinery and safety appliances, etc. Railroads sustain heavy losses from excessive awards of damages in cases of accidents, many of which are unavoidable so long as the human equation enters into the operation of railroads. The construction of parallel lines may at any time materially affect the earning capacity of a road. And not the least of the dangers to which railroads are exposed is ill-considered legislation by states and the federal government, at times when the waves of popular prejudices sweep over the land.

Capital is keenly alive to these dangers. It may be asked, who would have invested in American railroad securities if the rate of interest had been confined to the legal rates in the several states? And who is likely to furnish in the future the capital necessary to build new roads and to enlarge transportation facilities now so heavily overtaxed, if the returns on the capital is to be restricted? There are many other opportunities to earn the legal interest, or more, where ample security can be obtained for the regular payment of interest, as well as of the principal. Capital invested in hazardous enterprises must necessarily receive a large rate of profit as a reward for the risk. Investments in railroads are in a measure speculative. Investors expect to receive not only a reasonable rate of interest, but also a share of the advantages which flow from the growth of the country and from the skill and industry of the management. Why deny them the fruits of their skill and industry in the management of the property, or deprive them of an increment in the value of the property due to the development of the country?

RAILROAD CAPITALIZATION AND RETURN THEREON.

A suggestive comparison of freight and passenger rates, and the return on stocks and bonds during the past 23 years is brought forth in the following table:

Year.	Average rate				Earnings per mile of road (in operation)		Percentage of exp. to earnings.
	Per cent. Interest.	Div's.	Per ton.	Per pass.	Gross.	Net.	
1883	4.94	2.76	1.224	2.422	\$7,405	\$2,679	63.82
1884	4.82	2.50	1.124	2.356	6,663	2,318	65.22
1885	4.97	2.00	1.057	2.199	6,209	2,163	65.17
1886	4.86	2.02	1.042	2.194	6,570	2,376	63.83
1887	4.86	2.17	1.034	2.276	6,799	2,418	64.44
1888	4.48	1.80	0.977	2.246	6,540	2,045	68.72
1889	4.53	1.79	0.970	2.169	6,446	2,066	67.95
1890	4.44	1.82	0.927	2.174	6,875	2,166	68.50
1891	4.41	1.87	0.929	2.184	6,851	2,135	68.83
1892	4.25	1.93	0.941	2.168	6,852	2,068	69.82
1893	4.31	1.88	0.893	2.072	6,963	2,069	70.29
1894	4.19	1.66	0.864	2.025	6,054	1,803	70.22
1895	4.24	1.58	0.839	2.069	6,097	1,804	70.41
1896	4.45	1.52	0.821	2.032	6,233	1,840	70.43
1897	4.24	1.51	0.797	2.029	6,228	1,884	69.74
1898	4.21	1.71	0.758	1.994	6,771	2,111	68.16
1899	4.26	1.92	0.726	2.002	7,161	2,272	68.27
1900	4.27	2.44	0.746	2.031	7,826	2,519	68.93
1901	4.24	2.65	0.756	2.028	8,270	2,668	67.73
1902	4.10	2.97	0.764	2.012	8,696	2,830	67.45
1903	4.17	3.03	0.781	2.052	9,301	2,887	68.96
1904	4.01	3.31	0.787	2.053	9,248	2,989	67.68
1905	3.79	3.27	0.789	2.030	9,643	3,135	67.49

It will be seen that the highest average rate of dividend was 3.31 per cent. in 1904, and the lowest 1.51 per cent. in 1897. The two tables also furnish conclusive refutation of the theory that capitalization has any relation to rates and that increased capitalization must result in an increase of rates. It will be seen that the capitalization, including stock and bonded debt, increased from \$5,402,038,257 in 1880 to \$14,563,199,931 in 1905, or 170 per cent., and that during the same period the average rate per ton per mile decreased from 1.224 cents to 0.789 cents, or 35 per cent., and that the passenger rates decreased from 2.422 cents per passenger per mile in 1880 to 2.030 cents, or 16 per cent.

It will also be seen from the accompanying tables taken from the Interstate Commerce Commission "Statistics of Railways in the United States" for the decade ended June 30, 1905, that during that period of exceptional prosperity, shareholders, with few exceptions, did not receive a reasonable return on their investment.

FUNDED DEBT AND TOTAL CAPITAL OF RAILROADS IN THE UNITED STATES.

Year.	Total, funded debt.	Bonds.	Miscellaneous obligations.	Income bonds.	Equip-ment trust obligations.	Per cent. of cap-ital.	Per mile of line.	Total railroad capital.	Per mile of line.
1905	\$7,250,701,070	\$6,024,449,023	\$786,241,442	\$253,707,699	\$186,302,906	52.52	\$34,625	\$13,805,258,121	\$65,923
1904	6,873,225,350	5,746,898,983	723,114,986	229,876,687	173,334,694	52.02	33,429	13,213,124,679	64,265
1903	6,444,431,226	5,426,730,154	640,704,135	234,016,821	142,980,116	51.15	32,317	12,599,990,258	63,186
1902	6,109,981,669	5,213,421,911	564,794,588	242,556,745	89,208,425	50.35	31,371	12,134,182,964	62,301
1901	5,881,580,887	5,048,811,611	545,780,485	218,872,068	68,116,723	50.32	30,963	11,688,147,091	61,531
1900	5,645,455,367	4,900,626,823	464,983,341	219,536,883	60,308,320	49.13	30,210	11,491,034,960	61,490
1899	5,518,943,172	4,731,054,376	485,781,695	260,048,753	42,058,348	50.02	30,286	11,033,954,898	60,556
1898	5,430,285,710	4,640,762,632	486,977,279	262,194,688	40,351,111	50.19	30,289	10,818,554,031	60,343
1897	5,270,365,819	4,539,911,595	430,718,303	259,847,154	39,888,767	49.56	29,340	10,635,008,074	59,620
1896	5,340,338,502	4,517,872,063	457,735,531	314,425,977	50,304,931	50.54	30,126	10,568,865,771	59,610
1895	5,385,495,573	4,641,755,548	445,221,472	242,603,226	55,915,327	52.05	31,048	10,346,754,229	59,650

RATE MAKING ON THE BASIS OF VALUATION OF PROPERTY IS IMPRACTICABLE.

The Virginia and Kentucky cases furnish a striking illustration of the impracticability of government rate-making on the basis of valuation of property.

Let us assume, for further illustration, that a railroad commission has to establish freight tariffs for road A, built in a mountainous country, and at a cost of \$50,000 per mile; and also for road B, built in a valley or on a plain at a cost of \$25,000 per mile.

We assume further that there are important industrial establishments on both roads, which produce the same articles and ship them to the same markets. A tariff for road A that is 25 per cent. higher than that for road B must be considered as reasonable, both on account of the greater value of the property used, and the probable greater cost of operation. But what would be the result of such tariff? Obviously, road A would have reasonable rates; but road B would get all the competitive freights. The industrial establishments on road A would have to be closed. As the commission could not order road B to advance its rates (such advance might enable that road to earn more than a reasonable return on a fair value of the property used), it must say to road B: the rates we fix for you are maximum rates. You can charge as much less as you please. That would solve the problem; but what would become of the theory of rate-making?

Owing to the interdependence of rates, what is true of roads A and B is equally true of other roads in different sections of the country. Communities that are served by roads of small capitalization would have lower rates than those which are not so fortunate. The result would be unjust discrimination against localities, and hopeless confusion and disaster to commercial enterprises which depend on railroad transportation. Ultimately the roads which have the lowest capitalization would fix the rates for all the other roads in the same section, with which they compete either directly or indirectly, by competition between markets. This might mean bankruptcy to many railroads, unless they could make up for their losses on competitive business by putting heavier burdens on the local or non-competitive traffic.

The theory of rate-making on the basis of valuation of property ought to commend itself to the advocates of government ownership of railroads; for no more effective plan for depreciating the value of railroad securities could be devised. As a basis for rate-making this theory may be characterized as "the sublimity of absurdity," to borrow a phrase which President Roosevelt applied to another matter.

VALUE-OF-SERVICE PRINCIPLE.

About forty years ago, a friend of mine, then superintendent of a Virginia railroad, was asked by the chairman of an investigating committee of the Virginia legislature, "Why does your company charge \$1 per bale of cotton from local station A on your road to the terminal station B?" He answered promptly, "Because we can get it." A shout of derisive laughter followed, and the chairman added: "Oh! you charge all you can get, do you?"

The newspapers, and even some railroad men, did not fail to cast ridicule upon my friend; and yet he had stated in a few words, probably without being aware of it, the underlying principle of all railroad tariffs, and of the tariffs of tolls that applied to canals and turnpikes hundreds of years before railroads were dreamed of.

It is apparent that under no circumstances can a railroad charge a shipper more than such shipper is able to pay. It does not follow, however, that rates are made on a basis of charging all a shipper can afford to pay. Such a basis would be unfair, because it would deprive the shipper of his equitable share of the value created by the transportation. Hence, the rate would not represent the fair value of the service to the shipper. But the rate must also be fair to the railroad. Hence it follows that the fair value of the service is deter-

mined by what the shipper is able to pay to yield him such profit as he is willing to accept, and what the railroad can afford to render the service for. A railroad and a shipper may be said to be in partnership limited to each particular shipment. The shipper furnishes the article and the railroad the transportation, the profit from each transaction, that is, the earned increment of value created by the service, to be equitably divided between these partners. The first question to be determined is, can the article be transported at all? If the shipper's share of the value created by the service gives him no profit at all, and the railroad's share does not reimburse it for the expense of handling and moving the article, then the service is practically of no value, and the article cannot be transported. For example: if we assume that the increased value of an article by reason of transportation from the point of production (A) to the market (B) would be equivalent to 20 cents per 100 lbs., and the actual outlay of the railroad for handling and moving the article was 22 cents per 100 lbs., then the service is of no practical value, and the article cannot be carried. If, however, the shipper's share yields him such minimum profit as he may be willing to accept, and the railroad's share gives it something more, however little, than the expense of moving and handling the article, then the service is of some value, which may be designated the minimum value, and the article can be transported. The minimum value in such a case fixes the maximum rate that particular article can bear.

For instance: if the increase of value created by the transportation should be equivalent to 30 cents per 100 lbs., and the expense of handling and hauling is 22 cents per 100 lbs., then a rate can be fixed which will give some profit to the shipper, and give to the railroad something over the actual expense of handling and hauling. It follows that the rate must not be higher than the article can bear—the value of the service being determined by the ability to pay. This ability varies within wide limits with different articles, according to their values. For instance: silks and dry goods can bear higher rates than pig iron; manufactured goods can generally bear higher rates than the raw materials out of which they are made. Railroads classify their articles in accordance with the rates each article can bear, and for the purpose of so adjusting rates that every article contributes, in addition to the expense of movement, such proportion of the expenses of maintenance of way, track, bridges, buildings, general administration and taxes, and, if practicable, interest on the capital invested, as the value of the service enables each article to contribute.

The underlying principle of railroad classification is discrimination between different classes of freight in accordance with the value of the service and expense of operation. We will now see whether this theory can be applied to the practical work of rate adjustment.

It may be said that a railroad favorably located in respect to the sources of its traffic, and economically built and operated, should yield to its owner a fair return on the capital actually invested, and that rates should be so fixed that each article of freight carried over the road should pay the cost of its transportation, and in addition thereto, an equitable proportion of the fixed charges, and of the dividends to be paid to the stockholders. But the cost of transporting any article of freight is not known and cannot be ascertained; nor can the amount and character of the traffic which has to be assessed with these charges be known in advance. Moreover, the principles which should govern the equitable distribution of such charges remain to be discovered. But assuming that freight rates can be made according to this theory, it might, and probably would be, found that they were in many cases higher than the rates in effect on a competing railroad or water line—so that the rates made upon mathematical principles and according to rules of equity would be of no practical use.

As the value of service theory is correct, the above example merely shows that this method of application is impracticable. This, however, does not affect the correctness of the value of service principle.

How, then, are freight tariffs made?

It cannot be said that they are made in the sense that they are products of manufacture. It would be more correct to say that they are products of evolution. One generation transmits them to the next, with such additions and modifications as traffic conditions necessitated. It would be interesting to trace the development of modern freight tariffs from the simple rate sheets of the earliest days of railroads, to the modern, highly organized tariffs, with their elaborate classifications embracing thousands of articles, and to note that influence and effect of surrounding circumstances that from time to time necessitated modifications and additions—and, especially, the effect of increasing competition. Unfortunately, the information which would be necessary to make such a study is not obtainable.

It cannot be said that, in modern times, railroads make tariffs; they can only adjust them to varying conditions. This work is performed by a department known as the traffic department or commercial department. Rate adjusting is not a science, but a profession taught in the school of experience. The proficiency of traffic men can only be acquired by many years of practical work in the several branches of the service. Generally traffic men grow up with their respective railroads, and are familiar with the commercial and economic conditions of the country tributary to their respective railroads. They are in close touch with the public, either directly or through their numerous assistants—division freight agents, station agents, and soliciting agents. By being in close touch with shippers they can acquaint themselves with their needs and requirements. It has been said that traffic men should know the business of shippers almost as well as the shippers do themselves. These traffic men are also in close touch with the transportation departments of their respective roads, and keep themselves informed of the movement of traffic and the factors which influence the economy of movement. They know whether the road is being worked to its full capacity, or whether it is desirable to increase the volume of business and thus reduce the expenses of operation.

Adjusting freight rates is practical work of men who have special training for it and large experience. They may not all be able to explain underlying principles, such as the value of service, but they have used this principle for years, and apply it intuitively in every case which comes before them. Indeed, it has become with them a habit to apply it—not unlike the lawyer who is called upon to give opinions on questions involving facts and the law, the traffic man is called upon to decide rate questions with promptitude, upon the facts and the law, according to his best judgment. He must be familiar with commercial and economic laws, as well as state and interstate laws regulating rates. It is apparent that in adjusting rates, or in making new rates when it is within their power to do so, these traffic men decide what is an equitable division between the railroad and the shipper, of the increment of value. Frequently his decision results from bargaining and compromise. But generally it is arbitrary. Hence, laws regulating railroad rates are imperatively necessary, to give the shipper relief in case of errors of judgment of railroad men. While decisions of railroad men are necessarily arbitrary, it should be borne in mind that railroad men appreciate the importance of treating their customers fairly, and of fostering and developing the business of their roads. Railroad men can no more disregard the interests of the shipper than those of the railroads they represent. The saying that the interests of the railroads and the public are identical is trite, but true. The present laws afford ample protection to the shipper and to the railroads, except, as we have seen, in the case of state-made tariffs.

VALUE OF SERVICE THE CORRECT STANDARD OF REASONABLENESS OF RATES.

The standard of reasonableness of rates must fulfil the following conditions:

1. It must be based upon correct principles. The measure to be applied must have direct relation to the thing to be measured.
2. It must be in harmony with the underlying principles of practical rate adjustment.
3. The method of applying the standard in determining the reasonableness of a rate must be practicable.

We have seen that neither the theory of cost of transportation, nor of the fair value of the property need comply with any of these requisites. I believe that the value of service is the correct standard of reasonableness of rates; the principle constitutes a basis for judging rate questions that is broader and sounder than that now being used. It will clear the complex question of rate adjustment of irrelevant matter, and greatly simplify it. Of course, it cannot be made the basis of a formula for general application. Each case must be determined by itself on its merits according to the facts and the law bearing upon it in the same manner as the Interstate Commerce Commission and the courts do in cases arising under the Act to Regulate Commerce.

I believe that the value of service principle fairly and intelligently applied would result in conclusions that are just to the shipper as well as to the railroad.

SUMMARY.

I.

The value of the property used has no direct relation to rates; hence rates cannot be based upon such value, nor can their reasonableness be ascertained upon the basis of such valuation.

II.

The value of railroad property cannot be determined by a physical valuation. The only measure of value that can be properly applied is the earning capacity.

III.

The earning capacity depends on the rates that can be charged and upon the volume and character of the traffic. The rates depend upon commercial and competitive conditions. The volume and character of traffic depend upon the location of the road and the degree of success which has attended the efforts of the company to develop the resources of the country tributary to its railroad.

IV.

The value of the property used in any branch of the service multiplied by the reasonable percentage of profit, is no criterion of the reasonableness of rates on such branch.

V.

Railroad companies are not entitled to a reasonable return on the value of the property used. They are entitled only to what they can earn, be it much or little, by charging rates that are just, reasonable and undiscriminatory—the reasonableness of such rates being determined by commercial and competitive conditions and the value of the service to the shipper and to the railroad.

VI.

Rates adjusted on the value of the service principle intelligently and fairly applied are just, alike to the railroad and to the shipper.

VII.

The reasonableness of rates can only be determined by the facts bearing upon each particular case. Reasonableness of revenue is a legal fiction.

VIII.

The profits of railroad companies resulting from the volume of the business they have helped to create, and such reasonable rates as commercial and competitive conditions enable

it to charge, cannot be restricted to the usual rate of interest without doing injustice to the owners of such properties.

IX.

Unreasonable rates can be readily corrected under existing laws. The courts, state commissions, and the Interstate Commission have ample power to make such correction.

X.

Railroad companies have not the power to charge extortionate rates, nor is it to their interest to do so. Such rates would kill their business.

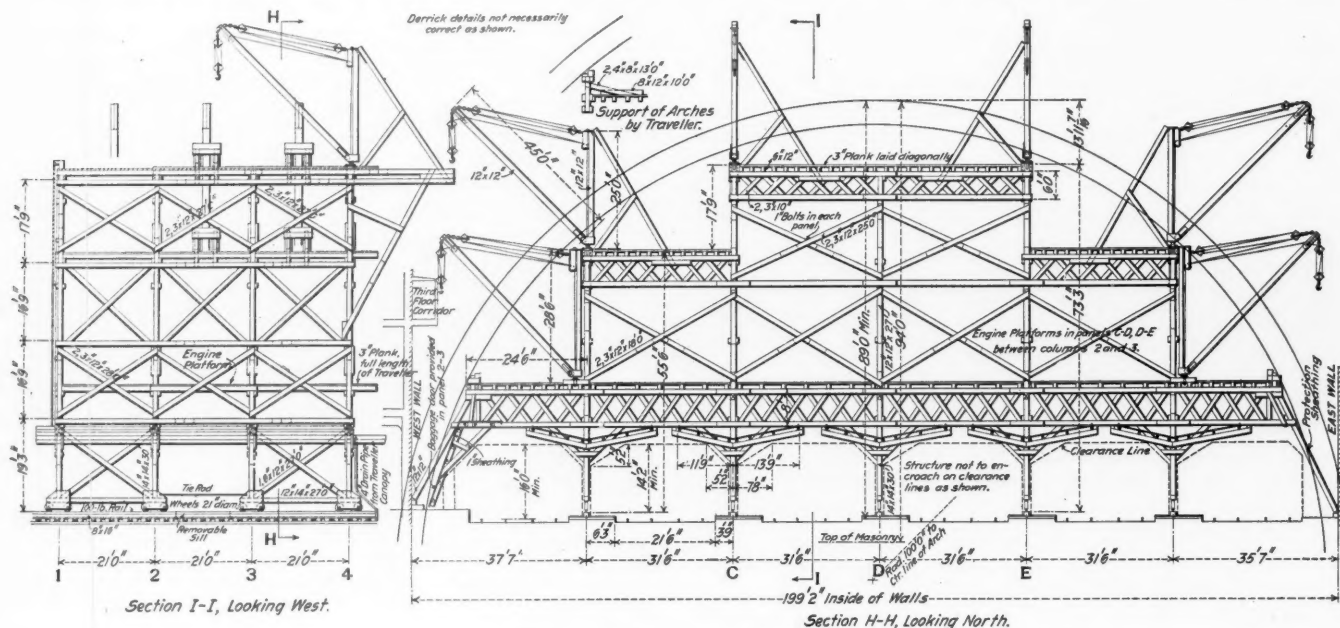
XI.

The underlying error of the demand for a valuation of rail-

REMOVING THE GRAND CENTRAL TRAIN SHED.

In making the terminal improvements at Grand Central Station, New York, it was originally planned to handle all traffic in the new Lexington Avenue terminal, while the old train shed was being removed. It turned out, however, that, because of the growth of traffic and the progress of excavation, this could not be done. The train shed is, accordingly, being torn down without interfering with the operation under it of the New Haven trains, and some of the Hudson division trains of the New York Central.

The whole shed north of the passenger waiting room is to



Traveler Used in Removal of Grand Central Train Shed.

road property is the assumption that railroads have the power to fix their rates and that they exercise it so as to produce an unreasonable return on the capital invested.

XII.

The statistics published by the Interstate Commerce Commission and by Poor's Manual for 1905, show that American railroads, with few exceptions, have not earned a reasonable return on the capital invested.

XIII.

The statistics also show that the increase of capitalization has been invariably accompanied by a reduction in passenger and freight rates.

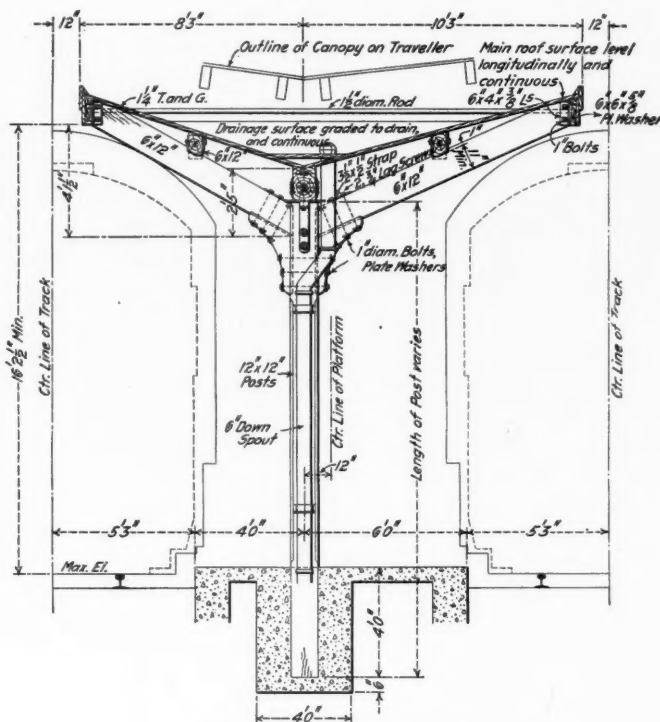
XIV.

Justice to the railroads and to their customers requires that the reasonableness of rates on interstate traffic be determined by the same method that the Interstate Commerce Commission and the federal courts employ in ascertaining the reasonableness of rates on interstate traffic; that is to say, upon the facts surrounding each particular case.

CONCLUSION.

The patient reader who has followed me can draw his own conclusions from facts which are mainly derived from official sources. While the experience I have acquired during my continuous connection with American railroads since 1851 may, perhaps, lend some interest to my personal opinions and conclusions, I can only claim that they have the merit of sincerity and frankness of expression. It may be said that I have wearied the reader with frequent repetitions of propositions that ought to be considered as self-evident. Such repetitions have seemed to be unavoidable in view of the prevailing misapprehension and confusion of ideas in regard to the best elementary principles involved in the determination of rate questions.

be removed. This is about 600 ft. long and is carried on arches of wrought iron brought from England and put up in 1870. These are trusses about 4 ft. deep, with 200 ft. 1 in. span, center to center of pins. From the inner side of the top of the

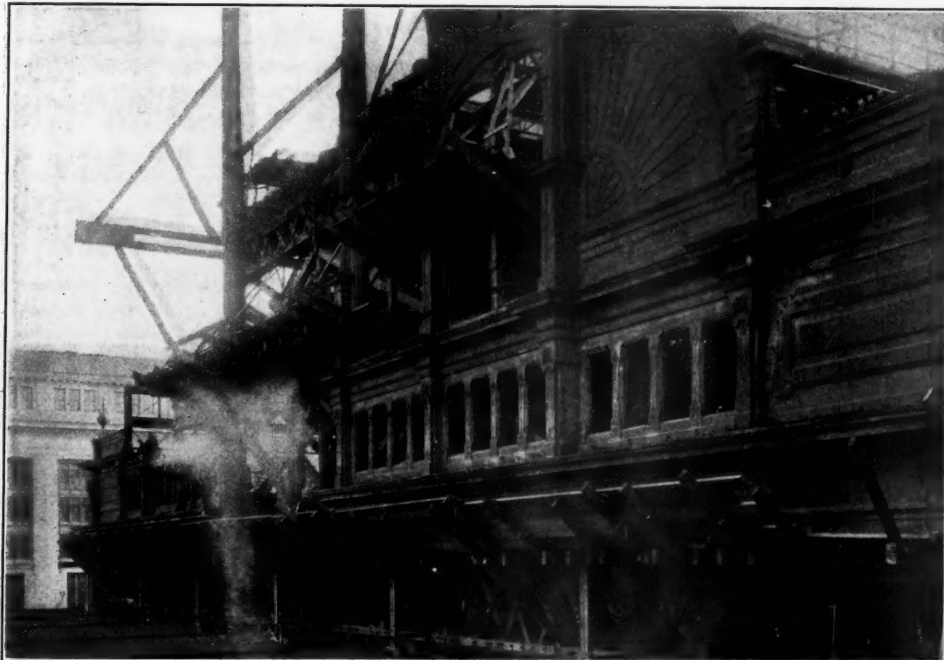


Cross Section of Canopy.

arch to the platform level is 85 ft. The bottom of the arches are tied together under the tracks with 3 in. rods. The arches are spaced 20 ft. 3 in. apart, center to center. The material to be removed includes 1,350 tons of wrought iron, 350 tons of cast iron, 90,000 sq. ft. of corrugated iron roofing, 60,000 sq. ft. of glass, and 530,000 bricks. All this has to be

part of the work of demolition was the first step, that of taking down the north portal. All connections between the portal and the shed were first cut away and beams made fast to the north end of the traveler were then pushed through the window openings or openings cut in the metal sheathing of the portal. The entire portal was then made fast to the

traveler, and the work of taking it down proceeded. The method of procedure with the station shed itself is as follows: Two arches are blocked up at once, and the roof, glass and purlins are removed. The arch is then cut up into eight sections with hacksaws and by knocking off rivet heads at joints. The sections are handled between the different floors of the traveler by the derricks. All this is done during the day. At night, work cars are run under the traveler and the dismantled material loaded into them and taken away. When two arches have been removed the traveler is shoved ahead to its next position by jacks. There are two 15-ton jacks on each platform. Each is worked by two men on signals, so that the whole movement is uniform. When the traveler has been moved 40 ft., which takes about four hours, it is blocked up and work proceeds on two more arches as before. As fast as the traveler moves inward it is followed up on

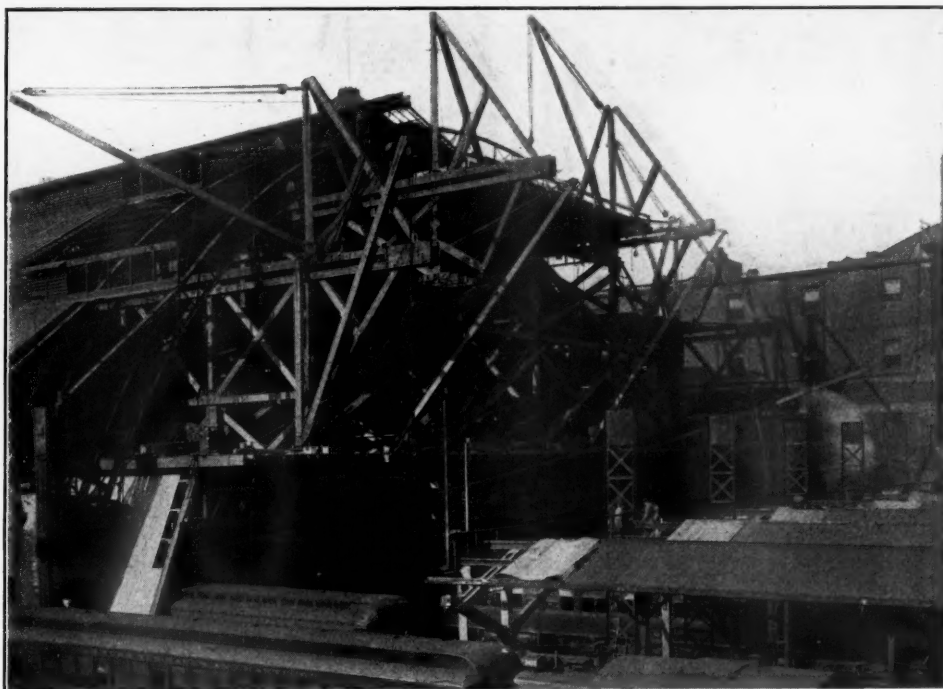


Removal of North Portal.

taken down, loaded into cars and hauled away without interfering with regular traffic.

A wooden traveler was built spanning all platforms and following the general contour of the shed. This structure is supported on the five intermediate platforms, as shown in the accompanying drawing, being carried on heavy cast iron wheels which roll on standard 100-lb. rails. The load on each platform is 200 tons, this including the weight of two of the shed arches when blocked up from the traveler as described later. The load is distributed over the entire width of the platform by ties under the rails. These are covered with temporary planking so that the platform can be used for regular business, the supports themselves taking up only a small part of the platform space. The traveler carries six stiff-leg derricks, which are operated by two stationary engines on the traveler. Wooden sheathing extends down from the first floor level of the traveler to protect people on the outer platforms from falling material. The southerly, or inner, face of the structure is boarded over, forming a false end for the train shed as the traveler moves inward.

In starting work, the finished members of the traveler were brought inside the train shed and erected at night, as far as the first floor. The rest was put up during the day, the separate members being brought in at night. The hardest



Removal of Grand Central Train Shed.

the outside with temporary wooden umbrella sheds of the butterfly type to protect the platforms. One of the accompanying drawings shows the design of these sheds. At the time the photographs were taken, the rate of progress was about 40 ft. in six days.

The traveler was designed by J. L. Holst, Engineer of Structures in the Electric Zone, who supervised its erection and is now in charge of the removal of the train shed. The

work is under the general supervision of G. W. Kittredge, Chief Engineer.

We are indebted to G. A. Harwood, Chief Engineer of Electric Zone Improvements, for the description of the work and for the accompanying drawings and photographs.

THE LARGEST BRIDGES IN THE WORLD.

BY HENRY S. JACOBY,

Professor of Bridge Engineering, Cornell University.

The frequent references in the *Railroad Age Gazette* to new records created by the increasing speed of trains or the performance of the latest type of ocean greyhounds; to the comparative heights of the tallest skyscrapers and the recent proposal to erect one higher than any other building or monument; to the comparative lengths of railroad tunnels or of tangents in railroad location; all show that there is considerable interest in such indications of progress in human achievement.

It seems therefore that it may be both interesting and useful for convenient reference to give in a single article a list of the longest spans of various classes of bridges and of a few of their sub-divisions. In all cases the spans are measured between centers of end bearings, except for the stone and concrete arches, where the clear span is given in accordance with the prevailing custom.

In the accompanying table the simple plate girder bridge is a deck structure and hence supports only a single track.

a number of ferry or transporter bridges have been built in recent years. The cantilever and suspension principles as well as the hinged arch have been employed to support the track in different cases. The longest bridge of this class crosses the River Mersey, between Widnes and Runcorn, England, with a span of about 1,000 ft.

The Forth cantilever bridge in Scotland still has the greatest span (1,710 ft.) for that class, although the ill-fated Quebec bridge was designed for a span of 1,800 ft.

The longest span for a stone arch is to be found at Plauen, in Saxony. It was completed in 1905 and has a clear span of 295.3 ft.

The longest bridge irrespective of the length of span or class of structure is the pile trestle bridge on the Louisville & Nashville Railroad across Lake Pontchartrain, near New Orleans, which is about 21 miles long. The longest truss bridge in this country is the Illinois Central Railroad bridge over the Ohio river at Cairo, Ill., the total length of metal structure being 10,560 ft. When completed in 1889 this bridge had trestle approaches making the total length 20,246 ft., but these were subsequently filled in. The Tay viaduct in Scotland, 10,800 ft. long, is the only metal structure that exceeds it in length, elevated railroad structures in cities not being considered in this comparison.

The widest bridge is in Chicago, where 33 tracks of the Erie Railroad cross Fifty-first street, its width being 433 ft. The widest highway bridge carries Main street in Lockport, N. Y., over the Erie canal. It is supported by 27 three-hinged

LONGEST SPANS OF AMERICAN BRIDGES.

Kind of bridge.	Span. Ft. Ins.	Crossing.	Location.	Traffic.	Date completion.
Simple plate girder.....	128 4	Yankee Run	Near Hubbard, Ohio.	Erie R. R.	1904.
Simple riveted truss.....	370 10	St. Francis River	Richmond, Quebec	Highway	1903.
Simple pin truss	585 0	Great Miami River	Elizabethtown, Ohio.	Highway	1906.
Simple combination truss.	300 0	..... River	Near North Yakima, Wash.	Highway	1903.
Continuous truss	408 0	St. Lawrence River	Lachine, near Montreal.	Can. Pac. Ry.	1887.
Plate-girder swing	196 0	Chickasaw Bogue	Four miles from Mobile, Ala.	Louis. & Nash. R.R.	1900.
Truss swing	521 0	Willamette River	St. Johns, Ore.	Northern Pac. Ry.	1908.
Trunnion lift	205 7	North Branch, Chicago River.	Northwestern Avenue, Chicago.	Highway	1904.
Rolling lift	275 0	South Branch, Chicago River.	Near 12th Street, Chicago.	Terminal Transfer Ry.	1901.
Hinged lift	153 0	Buffalo River	Michigan Street, Buffalo	Highway	1897.
Direct lift	130 0	South Branch, Chicago River.	South Halsted Street, Chicago	Highway	1894.
Aerial Ferry	393 9	Ship Canal	Lake Avenue, Duluth	Highway	1905.
Cantilever	1,182 0	East River	Blackwell's Island, New York	Highway	1909.
Suspension	1,600 0	East River	New York (Williamsburg Bridge)	Highway	1904.
Three-hinged arch	456 0	Mississippi River	Marshall Avenue, Minneapolis, Minn.	Highway	1889.
Two-hinged arch	840 0	Niagara River	Niagara Falls, N. Y.	Highway	1898.
Arch without hinges.....	519 9 3/4	Mississippi River	St. Louis, Mo.	Railroad	1874.
Wooden arch	192 0	Mendota Ravine	One mile west of St. Paul, Minn.	Highway	1889.
Stone arch	220 0	Cabin John Creek	Near Washington, D. C.	Aqueduct	1864.
Concrete arch	233 0	Wissahickon Creek	Walnut Lane, Philadelphia	Highway	1908.

The longest through plate girder span supporting a double track is 118½ ft. long, and is located at Gardner, N. Y., on the West Shore Railroad. In a four-track bridge which contains three plate girders, the middle one supports the load on two tracks, and the span for this arrangement is 107 ft. 8 in., being that of the New York Central & Hudson River Railroad bridge at Lyons, N. Y., the middle girder weighing 103 tons. A number of longer plate girder bridges designed for lighter loadings may be found in other countries, the longest one probably being on the Eastern Bengal Railway system in case it is still in service. The span is about 172 ft.

The maximum span of riveted simple trusses in other countries materially exceeds that in America on account of radical differences in bridge construction. Its length is a little over 500 ft., which is less than the span of the longest pin-connected simple truss bridge in this country.

There are a number of foreign continuous truss bridges which have longer spans than the Lachine bridge, the longest being the middle span of the Fades viaduct in France, erected a few years ago. Its length is 472 ft. 5 in.

The Tower bridge in London, built in 1894, has a span of 226 ft. 6 in., and is therefore the longest trunnion lift bridge in the world.

In the aerial ferry bridge referred to in the table, the track for the trolley car is supported by a simple truss. In Europe

arches and is 270 ft. wide. Both of these bridges have very short spans. The Cambridge bridge at Boston may be regarded as this country's representative wide bridge. It accommodates four car tracks, two highways and two sidewalks. Its width is 165 ft. and the longest span is 188½ ft.

The highest bridge in America is the Pacific Railway bridge over the Rio Grande river, 26 miles west of San Jose, in Costa Rica. The base of the rails is 340 ft. above the surface of the water, and the main span of the arch is 448 ft. 8¼ in. There are, however, six higher bridges in other countries, the highest one being the St. Guistina viaduct which crosses the Noce Schlucht in Southern Tyrol at an elevation of 453 ft. This is a highway bridge, but the next one in order is a railroad bridge known as the Fades viaduct, which crosses the valley of the Sioule river near Vauriat, France. The base of the rail is nearly 435 ft. above the bed of the stream.

The bridge supporting the heaviest load carries Seventh avenue over the tracks of the new Pennsylvania terminal in New York City. The load for which this bridge was designed averages 3,500 lbs. per sq. ft. for the full width of 78 ft. For 22 ft. of the width, the load averages 4,400 lbs. per sq. ft. The heaviest live load for which a bridge of long span is designed is 32,200 lbs. per linear foot, which is the assumed loading of the Blackwell's Island cantilever bridge over the East river at New York.

General News Section.

A press despatch from Duluth, Minn., says that so many men have gone west to work in the hay fields and wheat fields that there is an actual scarcity in the labor market.

The railroads of the state of Pennsylvania, acting through their car service associations, are going to submit to the state railroad commission uniform rules for demurrage on freight cars.

The two Public Service Commissions of New York State will hold a joint meeting at Albany August 4 to consider the adoption of a uniform system of account-keeping to be prescribed for the street railroads of the state.

The Baltimore & Ohio, which has kept a large proportion of its shop men at work nearly on full time, in spite of dull traffic, has at last been compelled to order a suspension of work at all of its shops during one week of each month.

Judge Brodrick, at Bellefontaine, Ohio, has decided that a local magistrate, who fined trainmen \$50 each for running a train at excessive speed through a village, exceeded his authority; that a town or village has only a civil remedy against offenders in such cases.

Promoters of the Nebraska Railroad Employees' Association say that within a few weeks there will be a local organization of the association at each division point on every railroad in Nebraska. The Association has organizers working in all parts of the state.

In connection with a recent derailment of a passenger train at Greenwich, Conn., killing a passenger, the coroner, according to the press despatches, caused the arrest of the engineer, the conductor and the conductor of the parlor cars. Why he did not arrest the dining-car cooks and a passenger or two, is not stated.

At Ashtabula, Ohio, according to a local report, the Pennsylvania is taking off the rails all wooden gondola cars of less than 100,000 lbs. capacity. About 300 cars were marked for treatment in this way. Only steel cars are being repaired. Somebody has said that on cars standing on the ground taxes will not be so high as on those which are on the track.

The Atchison, Topeka & Santa Fe has opened a new hospital at La Junta, Colo., for the benefit of its sick and injured employees. The building is modern in every respect and has accommodations for 60 persons, being designed to take care of the patients in the territory between Newton, Kan., and Las Vegas, N. Mex. The structure cost \$55,000.

The successful candidates for the Frank Thomson Scholarships this year, awarded to sons of employees of the Pennsylvania Railroad system, to enable them to secure a college education, were Merritt E. Gill, son of Newton L. Gill, employed in the General Freight Department of the Grand Rapids & Indiana, and Harry Wallis Anderson, son of J. H. Anderson, an employee in the office of Charles E. Pugh, Second Vice-President of the Pennsylvania.

At Sparta, Ill., on Sunday last, five negro ruffians in an attempt to run a freight train for their own convenience engaged the crew of the train in a desperate fight, in which one of the sheriff's assistants, who had come to the relief of the trainmen, was killed and the leader of the bandits was fatally wounded. Near Stamford, N. Y., on the evening of July 23, the mail clerk on a train of the Ulster & Delaware was overpowered by two robbers, who stole his watch and money and escaped from the train at the next station.

The Texas Railroad Commission has ordered the railroads in the state to file by September 22, for the period from July 1, 1907, to June 30, 1908, reports of the "cost and performance of locomotives" and "cost and statistics of train service" upon blank forms to be furnished by the Commission. Railroads that have complied with the provisions of the Commission's

order "A 4" are exempt. The Commission also ordered that every road in the state, beginning July 1, 1908, shall file, within 60 days after the end of each month, monthly reports showing the "cost and performance of locomotives" and "cost and statistics of train service."

The Illinois Central has decided that hereafter no intoxicating liquors shall be carried on the dining and buffet cars south of the Ohio river. Some states and many towns through which the road runs south have adopted prohibitory laws. It was found where the liquor selling had to be discontinued and then resumed several times on a trip there was dissatisfaction among the passengers, and there was less trouble if passengers were informed that there was no liquor on the train. Several states have gone the local option people one better by enacting laws which even forbid a passenger on a railroad to take a drink from his own bottle. This law, passed by the Louisiana legislature at its last session, went into effect in that state last week, and Texas has had a similar law in force for some time.

The Great Northern has addressed a circular letter to dealers in and consumers of coal in the Northwest, calling their attention to the fact that the movement of coal from the head of the lakes to country points in the Northwest thus far this season has been abnormally small and that unless immediate steps are taken to order supplies of coal and secure its movement, there is sure to be not only a shortage of transportation facilities next fall and winter, but an actual shortage of coal on the docks at the head of Lake Superior. Dealers and consumers are warned to "remember the winter of 1906-07." Two millions of tons less of bituminous coal had come through the Sault Ste. Marie canal into Lake Superior up to July 1, 1908, than during the same period of 1907, and the decrease in the movement of anthracite was 70,000 tons.

The decision at Chicago last week nullifying the \$29,240,000 fine which was imposed by Judge Landis on the Standard Oil Company brought out the following statement from Oyster Bay: "The President has directed the Attorney-General to immediately take steps for the retrial of the Standard Oil case. The reversal of the decision of the lower court does not in any shape or way touch the merits of the case, excepting so far as the size of the fine is concerned. There is absolutely no question of the guilt of the defendants or of the exceptionally grave character of the offences. The President would regard it as a gross miscarriage of justice if through any technicalities of any kind the defendant escaped the punishment which would have unquestionably been meted out to any weaker defendant who had been guilty of such offence. The President will do everything in his power to avert or prevent such miscarriage of justice."

Three-Cent Fares in Cleveland.

A press despatch from Cleveland, July 28, says that the promised universal 3-cent street car fare had been put in effect. Three-cent fare is charged, as has been the case for three months, and an extra cent is charged for transfers also as has been the practice for more than two months, or since transfers were permitted at all. The cent paid for a transfer is now refunded by the conductor to whom the transfer is presented. This system is adopted that the transfer privilege shall not be abused, and that all transfers shall be used, or the cent paid for them retained by the company.

The situation on July 19 was summarized in the press despatches as follows: Cleveland has had nearly three months of 3-cent street car fare, and two of the monthly reports have shown a deficit. A similar report is predicted for July. Operating expenses and fixed charges have been from \$40,000 to over \$50,000 a month in excess of earnings. The Municipal Traction Company, which is operating the local lines under a lease, is under a promise to give free transfers July 28. The

revenue from transfers has been about \$30,000 a month, a cent apiece having been charged. Several weeks ago President A. B. Dupont, of the operating company, stated that he expected the company to lose money during the first year. One drawback the company sustained was the strike in May, when few patronized the cars. This was followed not only by heavy strike expenses, but inexperienced conductors did not collect all fares. Officers of the company still express the belief that 3-cent fares will pay in time. "The property will not be turned back to the old company if we have to charge the highest rate of fare allowed by our franchise," President Dupont has said. The franchise permits a rate of six tickets for 25 cents.

Disastrous Flood in Loetschberg Tunnel.

According to a press despatch from Berne, Switzerland, July 24, 25 men working in the Loetschberg tunnel, in the Berne Alps, were drowned by tapping a river. The men were drilling inside the tunnel. Without warning their tools pierced the wall that separated them from a subterranean river or lake the existence of which was not known. The wall gave way with a crash, and a torrent of water and mud rushed into the tunnel and filled it. All of the workmen were drowned. They were Italians. Fortunately, owing to the early hour, only comparatively few men had entered the tunnel. The disaster occurred 2,400 yards from the northern entrance. It is believed that the men tapped the Kander river, which flows through the mountains above the tunnel. The water now chokes the tunnel to within 1,000 yards of the entrance. It is impossible to reach that part of the tunnel where the disaster occurred. Two bodies, however, were carried out by the rush of water and mud and have been recovered.

The Hours-of-Labor Law.

At Philadelphia, July 25, the Pennsylvania and Lehigh Valley Railroad companies filed a bill in the United States Circuit Court for an injunction to restrain the Interstate Commerce Commission from taking any further proceedings in pursuance of its order of March 3 to enforce the hours-of-labor law. The petition alleges that the order of the Interstate Commerce Commission requires the railroads each month to make a detailed report of all instances where trainmen had been on duty for longer periods than the time prescribed by the act of Congress. The bill denies the power of the Commission to make such an order and alleges that the purpose of it is to get evidence to lay before the United States District Attorney in criminal suits, thus to compel the railroads to furnish evidence against themselves for breaking the law.

The Erie has entered a similar suit in New Jersey.

Chairman Knapp, of the Interstate Commerce Commission, and Commissioner of Labor Neill, constituting the mediation board under the Erdmann act, have gone to Chicago to confer with officers of a number of western railroads and the Order of Railway Telegraphers with a view to effecting an adjustment of the controversy growing out of the interpretation of the nine-hour labor law.

Causes and Sources of Claims.

The stream of loss and damage claims may be likened to a great river. The sources of the stream are little springs. The bill clerks are one spring. The General Manager comes in on this. He thinks that four bill clerks are enough at a large shipping station office, where they have from 1,500 to 2,500 "tickets" a day; hundreds more than the very best men can properly handle. The bill clerk has to show all the items, shipper, consignee, destination, route, interchange points, weights, rates, divisions, extensions, etc. Has to insert car numbers and initials, pro numbers, waybill numbers, and all sorts of things that require an infinity of information, and the most careful attention—even some deliberation. How much deliberation can a man give who has to bill out 400 or 500 tickets as his day's stunt?—S. D. Webster, St. Louis.

Traffic News.

Chicago reporters estimate that not over 40 per cent. of the vessels on the great lakes, measuring by tonnage, are in the service this year.

Notice has been given by certain railroads at Cincinnati that the time allowed for unloading certain kinds of bulk freight, heretofore 72 hours, will be reduced to 48.

A passenger officer in Ohio says that although passenger business has been good during the past few weeks, the revenues from dining cars have fallen off 20 per cent., indicating that traveling salesmen are staying at home.

H. M. Adams, General Freight and Passenger Agent of the Spokane, Portland & Seattle, has announced that the extension of this line from Vancouver, Wash., to Portland, Ore., will be completed on August 15 or very soon after that date, and that through passenger train service will be established between Portland and Spokane, in connection with the Northern Pacific. Portland will thus have two direct lines to Spokane.

The Minneapolis, Red Lake & Northern has notified the Minnesota Railroad Commission that beginning on August 1 it will advance its passenger fares to the basis of 3 cents per mile, thus ignoring the state two-cent fare law. The road some time ago represented to the Commission that it could not profitably carry freight at the rates established by the legislature, and the Commission exempted it from the provision of the law.

The State Railroad Commissioners of Montana are proposing to order radical reductions in freight rates on ores in that state, provided that it shall be found for the public interest to do so, and have held a hearing on the subject. According to the press despatches, some of the largest shippers testified that reductions in freight rates would not increase their business; but it seems to be the general opinion that severe reductions will be ordered within a month or two.

The Railroad Commission of Texas has decided that it will take no step to prevent the railroads from putting into effect recent advances in interstate rates to Texas points. Commissioner Colquitt proposed that the Commission should take up with Governor Campbell the advisability of applying to a federal court for an injunction to restrain the Southwestern Tariff Committee and the railroads composing it from putting into effect the higher rates, but Chairman Mayfield and Commissioner Storey voted down Mr. Colquitt's motion.

The Denver & Rio Grande having inquired of the Interstate Commerce Commission has been informed that through passenger rates made up of rates of different classes will not be approved. The D. & R. G. had proposed to sell tickets to New York which should provide for a first class passage to Chicago and a second class passage from Chicago to New York. This arrangement was designed to secure for passengers the convenience of through checks for their baggage while at the same time giving them the benefit of the very low second class rate—\$10—now prevailing between Chicago and New York.

The Metropolitan Line, which runs the turbine steamships "Hartford" and "Yale" between New York and Boston, now does a heavy passenger business. The steamers' capacity is being tested to the utmost and the best accommodations can only be had by ordering well in advance. The gross earnings of these two boats are at the rate of about \$17,000 a day. As a result of this exceptionally heavy travel the company finds itself in the most comfortable financial position in over a year. These increased earnings will not directly benefit the Consolidated Steamship Lines Co., of which company the Metropolitan was once a part as, it is understood, in the reorganization the Metropolitan will not be included.

The Chicago & Alton has announced that, effective on September 7, it will apply the Chicago rate on shipments from the Illinois Tunnel Company's public stations at Chicago between Chicago and Ohio river and southwestern points. This action of the Alton makes it practically certain that the tunnel charge of 6 cents will sooner or later be absorbed by all

Chicago lines. The Erie, the Wabash and other eastern roads first announced the absorption of the charge. Then some of the southeastern lines took similar action. They were followed by the Illinois Central, which announced that it would absorb the charge on shipments to and from New Orleans, but not on shipments to and from East St. Louis. The Chicago & Alton will absorb the charge on shipments to and from East St. Louis.

A federal grand jury at Chicago has returned indictments against the Chicago, Rock Island & Pacific and the Illinois Central, alleging that they had unlawfully issued annual passes to caretakers of fruit. The law is held to provide only for trip passes to such caretakers; also the roads failed to publish in their tariffs the fact of the issuance of the annual passes. The Illinois Central is charged with favoring the Fruit Despatch Company, a subsidiary of the United Fruit Company, and the Rock Island the Liebhard Fruit Company, the Humphrey Commission Company, the Lawrence Hensley Fruit Company and the Donaldson-Howard Commission Company, all Colorado corporations. It is charged that annual passes were not issued to caretakers for any other fruit companies. When the Interstate Commerce Commission indicated to the roads its belief that, in issuing annual passes they were violating the law, the use of such passes was discontinued and mileage books on the certificate plan were substituted for them and have been used ever since January 1, 1908.

INTERSTATE COMMERCE COMMISSION.

Storage Charges at Pittsburg.

Wilson Produce Co. et al. v. Pennsylvania Railroad. Opinion by Commissioner Lane.

The defendants have put into effect a local freight charge for storage on carload freight at produce yards at Pittsburgh. Fruit or produce, heretofore, has been sold in many cases directly from the car, and cars were held by shippers for some time in order to get good prices for their fruit or produce. This practice was the cause of congestion at certain times in the year and deprived other shippers of the use of produce cars at the time when they were most in need of such cars. There is a Pennsylvania statute fixing charges which the railroad may impose for time rate of storage on these cars. Storage charges when associated with an interstate movement are matters for regulation by the Interstate Commerce Commission directly and shipment is not completed until arrival at destination and delivery to the consignee.

In the case of *Interstate Commerce Commission v. Detroit, Grand Haven & Milwaukee*, the Supreme Court suggested that the commission would be acting within its power in ordering a railroad company to regard cartage when furnished free as a permanent charge and include it in their schedule. Federal authority in this province is exclusive. In this case a sliding scale which starts 48 hours from the time the car is placed in the yard and charges \$1 a day for the second 48 hours, \$3 per day for the third 48 hours, and \$4 per day for each succeeding day is reasonable, and the complaint is dismissed.

Bulk Shipments of Express and Less than Carload Freight.

California Commercial Association v. Wells, Fargo & Co. Opinion by Commissioner Lane. Commissioner Harlan and Chairman Knapp dissenting.

Complainant is a voluntary association of wholesale and retail merchandise dealers of San Francisco, Cal. On August 17, 1907, a number of packages of merchandise aggregating 16,000 lbs. were assembled in New York and offered to defendant as one shipment consigned to the complainant. The rate on a shipment of over 10,000 lbs. and less than 20,000 lbs. was \$8.00 per 100 lbs. The rate on shipments of 500 lbs. and less than 1,000 lbs. was \$12.00 per 100 lbs. The express company has a rule which does not permit its agents to accept bulked shipments intended to be distributed by the consignee unless the higher rate is paid, as if the combined packages of merchandise were each shipped separately. It is claimed that the complainant is a common carrier and cannot demand the benefit of another common carrier's transportation facilities. But the complainant does not hold itself in any

sense as a carrier. It does not transport goods nor have custody of them while in the course of transportation. The fundamental question involved in this case is the right of a carrier to determine what shippers may use its published rates. It is the contention of the defendant that it may refuse to grant the bulk rate, which in this case is analogous to the carload rate made by a railroad company, to any but single owners of such shipments, because to allow any one else to use this bulk rate would encourage the establishment of forwarding agencies. The defendant claims that the forwarding agency will give one shipment one rate, a second shipment another rate, and so on, and the uniformity of rates as between rates of shippers will be destroyed. Although this may be true, the carrier makes but one rate and it is not within the carrier's province to inquire what use is to be made of goods offered to him for shipment after these goods have been delivered to the consignee. The carrier deals with the shipment that is tendered, not with its ownership nor with its ultimate use, and it deals with the shipper who tenders it, not with the owner of the property nor the last and most remote person to whom it is distributed. To leave this straight course, no matter to how slight a degree or for what apparently beneficial purpose, is only to lead away from a policy of the law which condemns discriminations and preferences. Carriers are compelled to charge the same rates for shipments received under substantially similar circumstances and conditions, and the Supreme Court held in the case of *Wight v. United States*, that the phrase "under substantially similar circumstances and conditions" refers to the matter of carriage. It has always been held that a carrier may charge more for L.C.L. shipments than for carload shipments and that an express company may charge more for a number of small packages than for one large package, but the permitting of this discrimination is based on the fact that it cost the carrier less to handle carload shipments for large packages than it does to handle L.C.L. shipments for a number of small packages. The defendant's rule against shipments intended to be distributed by the consignee is illegal and complainant is entitled to reparation.

Commissioner Harlan, in dissenting from this opinion, said that all that is said by Chairman Knapp in his dissenting opinion in the *Export Shipping Co.* cases (see below) applies with even greater force here, and there is the additional question of how far a carrier may be compelled against his will to serve a competitor to the detriment of his own interest. In the majority opinion it is said that a forwarder is not a common carrier and therefore is not a competitor of an express company. This obviously is a strict, technical view of the status of a forwarder, for while he may not incur the liabilities of a common carrier he is nevertheless engaged in the business of transportation. By getting in between the express company and the shipper, the forwarder is able to give the shipper a rate that has no lawful existence and is subject to no regulation or control, a rate which the express company could not lawfully give to the shipper or the shipper accept from the express company. While the immediate result of this decision may be to enable the forwarder to carry on his business at the expense of the revenues of the carrier, the ultimate result will be to require the shipping public to support both the carrier and the forwarder. Chairman Knapp concurs in this dissent.

Export Shipping Company v. Wabash et al. Same v. New York, Chicago & St. Louis et al. Same v. Baltimore & Ohio. Opinion by Commissioner Lane. Chairman Knapp dissenting.

The complainant is a corporation engaged in the business of forwarding agent and custom house broker at Chicago and New York. The official classification to which the several defendants in these cases are parties provides that a carload rate will not be given to a shipment when the consignor or consignee is not the actual owner of the property, and that shipments of property combined into packages by forwarding agents will only be accepted when the names of the individual consignors and final consignees as well as the character and contents of each package are not declared to the forwarder railroad agent, and furthermore such property will be billed as separate shipments and freight charged accordingly. The cases are governed in all respects by the decision in the *California Commercial Association v. Wells, Fargo*

d Co. and therefore complainant is entitled to reparation, and the regulations of the carriers just mentioned are held to be unlawful. Chairman Knapp, dissenting, said that the forwarding agent finds his compensation and profit in the difference between the carload and L.C.L. rates, the customer secures the carriage of his property at a lower rate than the L.C.L. rate which would otherwise be applied. He saves money, and the division of the difference between the carload rate and the L.C.L. rate is a matter of private bargain between him and the agent. Not only may there be a discrimination between individuals who make L.C.L. shipments, but there may also be discrimination between localities. In southern territory the forwarding agent could combine for the purpose of carload rating only 22 per cent. of the articles having L.C.L. ratings, and in western territory, only 29 per cent. of such articles, while in official classification territory 75 per cent. of such articles could be combined. Thus in official classification territory the carrier's gross revenue will probably be considerably reduced, while in western and southern territory there will be only a very small reduction in the carrier's gross revenue. The intervention of the middle man, in this case the forwarding agent, means another person who must make his living out of the transportation of L.C.L. shipments. The net revenues of the carriers will be reduced because the L.C.L. plant, so to speak, would have to be maintained on a diminished revenue.

STATE COMMISSIONS.

Wisconsin—The Commission's Authority Over Interstate Rates.

G. L. Dyer v. Chicago, Milwaukee & St. Paul.

The complainant who manufactures ice cream and runs a general store at Fall River, a town of between 400 and 500 inhabitants, has asked that train No. 5 on the Chicago, Milwaukee & St. Paul be compelled to stop at Fall River to deliver and take on green fruits, vegetables, ice cream and other perishable merchandise. This train is a fast interstate train, and while unquestionably the stopping of the train would be a convenience for the inhabitants of Fall River and a great advantage to the complainant in particular, these advantages would not justify the inconvenience to passengers who use the train between Chicago and Minneapolis. The average running time, including stops, is 31.5 miles an hour. Because of the interstate character of the train the Commission has very limited authority over its operation. The only ground upon which interference by state authorities in the operation of such a train is tolerated is the failure of the railroad to furnish a community with such service as it is entitled to, in which case the company may be required to stop the interstate train. In the case under consideration, the town of Fall River has reasonable railroad service as compared with other small towns in the state and the Commission therefore refuses to order train No. 5 to stop at Fall River.

Much Talk About Freight Rates.

The question whether the railroads of the country shall make a general advance in freight rates, and if so, when, has produced during the last week many thousands of printed words, but very few ideas. To the newspaper reader the situation is analogous to that which in London is called the newspaper silly season. In hot weather, when news is scarce, everybody with an argument for a "cause" or a grievance against society writes to the *Times*, or to some other paper, with the peculiarity that only academic subjects are dealt with. Serious matters are left until such time as everybody becomes rational again. Likewise here the real issue seems to be postponed while everybody beats the air again. The railroads continue to assert that the general level of rates has long been below normal; that the traffic managers know enough not to order increases which will damage their business by checking trade, and that most of the proposed increases will make only infinitesimal differences to the consumer. The spokesmen of the boards of trade and other mercantile associations declare that an increase is an increase, and that no disguise will fool them; that the merchant cannot pass a small burden

along to the consumer and so must take the whole of the addition to his freight bills out of his own small profit, and that the courts, Congress and the President will be besieged day and night before they will submit to higher freight rates. How accurately these spokesmen represent real sentiment it is impossible to say. The impression that one gets from reading their column interviews is that they have thought only of generalities. Their statements are such as every merchant will agree to—until he finds it necessary to deal with details. On the other hand prominent shippers, like W. E. Clow, of Chicago, and John Claffin, of New York, who understand that the consumer and not the middleman "pays the freight," have come out in interviews declaring that they do not oppose the advancing freight rates.

Following are the principal incidents of the week:

Governor Comer, of Alabama, speaking to a reporter, says that the state will resist in the courts the increase in freight rates proposed by the railroads south of the Ohio and east of the Mississippi rivers. At Little Rock, Ark., the merchants engaged counsel to resist in the courts any action taken by the railroads. At New Orleans the wholesale grocers are represented by the president of their association as "considerably stirred up." A press despatch from Galveston says that the Texas state railroad commission, "responding to appeals," will take action to regulate interstate rates. At Chicago, July 24, a committee, said to represent shippers' organizations in all parts of the country, met and adopted a resolution inviting the presidents of the railroads in Official Classification Territory to meet and discuss with them the proposed advance in freight rates.

The Receivers and Shippers' Association of Cincinnati sent a communication to President Roosevelt, calling his attention to the fact that the Missouri Pacific and the Chicago, Rock Island & Pacific, among other lines, have recently made advances in interstate rates to Texas points, and recalling that these roads were among the defendants in the Trans-Missouri Freight Association case decided by the United States Supreme Court in March, 1897, as a result of which decision these two roads and others were permanently enjoined under the Sherman law from conspiring or agreeing to advance or maintain rates.

At New York the Manufacturers' Association and the National Wholesale Dry Goods Association have published long protests. In Georgia, on application of the Macon Grocery Company and other merchants and mercantile corporations, Judge Speer, of the United States Court, has granted a preliminary injunction restraining the Atlantic Coast Line, the Louisville & Nashville, the Nashville, Chattanooga & St. Louis, the Cincinnati, New Orleans & Texas Pacific, and the Southern Railway Company from putting into effect the increased rates on certain commodities from the west which the railroads have given notice will take effect on August 1. Judge Speer set a hearing for July 29 at Mount Airy.

At Washington, July 27, the Interstate Commerce Commission, acting, it is said, on a suggestion of President Roosevelt, announced that if a general increase of rates is promulgated by the railroads an investigation will be made without waiting for the rates to go into effect actually, or for any one to complain.

M. K. & T. Passenger Earnings.

The earnings of the Missouri, Kansas & Texas for the fiscal year ended June 30, 1908, compare with the earnings for the preceding fiscal year as follows:

	1908.	1907.	Change.
Freight	\$15,400,006.20	\$18,402,825.15	Dec. \$3,002,818.95
Passenger	6,343,934.91	6,278,608.30	Inc. 65,326.61
Mail	525,783.55	533,798.11	Dec. 8,014.56
Express	604,388.82	585,916.07	Inc. 18,472.75
Miscellaneous	409,556.37	382,811.24	Inc. 26,745.13
Total	\$23,283,669.85	\$26,183,958.87	Dec. \$2,900,289.02

While there was a decrease of 17 per cent. in freight earnings during the year, the earnings from passenger business show a small increase in spite of legislative reductions in the rate of fare in some of the states through which this road runs. The percentage of passenger earnings to gross earnings on the Missouri, Kansas & Texas was extraordinary, considering the territory through which it operates and the legislation.

Northwestern Lumber Rate Decisions to be Appealed.

It has been definitely decided by the transcontinental railroads to appeal to the federal courts from the decisions of the Interstate Commerce Commission in all of the northwestern lumber rate cases. The decisions in these cases were abstracted in the *Railroad Age Gazette* June 26, pages 401 and 402, and were discussed July 17, page 508.

The Southern Pacific has filed a petition in the United States Circuit Court at San Francisco, Cal., for a temporary injunction to restrain the Commission from enforcing its order in the case of the Western Oregon Lumber Manufacturers' Association et al. v. Southern Pacific, et al., involving the rate on rough green lumber from the Willamette valley to San Francisco, which the Commission ordered reduced from \$5 to \$3.40. This case was set by the Court for hearing on August 3, but it is probable the hearing will be postponed until October.

This is the only case in which the roads will seek to get an injunction to restrain the Commission from enforcing its order. The Commission has permitted the roads to postpone until October 15 the filing of the tariffs prescribed by its order. The present purpose is to publish all the rates fixed by the Commission except those involved in the Willamette valley case, and to file and put them in effect on October 15. The rates fixed by the Commission will then be attacked in the courts and the courts will be asked to determine their reasonableness and to set them aside on final hearing.

Equipment and Supplies.

LOCOMOTIVE BUILDING.

The *Cazenovia & Sauk City* is in the market for a number of locomotives. Address, Joseph Duren, Cazenovia, Wis.

CAR BUILDING.

The *Central of Georgia* is asking prices on passenger cars.

The *New York Central & Hudson River* is asking prices on seven mail cars.

The *Illinois Traction System*, Champaign, Ill., has ordered eight large interurban cars and two sleeping cars from the Danville Car Co.

The *Chicago & Southern Traction* is said to have ordered one express and baggage car from the Niles Car & Manufacturing Co. This item is not yet confirmed.

The *Buffalo, Rochester & Pittsburgh* has ordered from the American Car & Foundry Co. the baggage and mail car, and the two baggage and express cars mentioned in the *Railroad Age Gazette* of July 17. They will measure 66 ft. long and 9 ft. 8 in. wide over sills; 10 ft. 2 1/8 in. high from bottom of sills to top of roof; 68 ft. 4 1/2 in. long, and 10 ft. 1/2 in. wide, over all, and 14 ft. 1/8 in. high above the rail. The bodies will be of wood, and the underframes will be composite. The special equipment includes:

Bolsters.....Cast-steel combined double body bolsters and platforms; Commonwealth Steel Co.
Brakes.....Westinghouse high-speed
Brake-beams.....Davis solid truss
Brake-shoes.....Flanged; Am. Brake-Shoe & Fdy Co.
Couplers.....Buhoup, 3-stem
Draft gear.....Westinghouse friction
Heating system.....Consolidated Car Heating Co.
Journal boxes.....McCord
Lighting system.....Pintsch inverted mantles
Paint.....Murphy varnishes
Platforms.....Blind ends
Roofs.....Plain monitor type
Side bearings.....Miner gravity
Springs.....Railway Steel-Spring
Vestibules.....Pullman standard
Vestibule diaphragms.....Ajax
Wheels.....Rochester sash locks and
Window fixtures.....Forsyth deck sash ratchets

The *Canadian Northern* has ordered three sleeping cars from Barney & Smith, for September 1 delivery. These cars will have 12 sections and a drawing room, and will be 72 ft. 6 in.

long and 9 ft. 10 1/2 in. wide, over all. The bodies and underframes will be of wood. The special equipment includes:

Brake rigging.....Hodge system, high-speed
Brake-shoes.....Steel back
Couplers.....Chicago Steel
Curtain fixtures.....Forsyth
Curtain material.....Pantasote, silk faced
Draft gear.....Miner tandem
Heating system.....Gold
Lighting system.....Commercial Acetylene
Side bearings.....Susemhl, roller
Trucks.....Six-wheel
Ventilators.....Arnoldi
Vestibules.....Pullman, wide type
Vestibule diaphragms.....Ajax
Window fixtures.....Knapp

The *Boston & Maine* has ordered from the Laconia Car Co., for January, 1909, delivery, the 18 passenger coaches (non-vestibule) mentioned in the *Railroad Age Gazette* of July 17. They will have a capacity of 76 passengers and will weigh 84,000 lbs. They will be 60 ft. 2 1/2 in. long and 9 ft. 1/4 in. wide, inside measurements, and 68 ft. 1/2 in. long over platforms, 10 ft. 2 1/4 in. wide over eaves, and 14 ft. 4 in. high over lamp jacks. The bodies and underframes will be of wood. The special equipment includes:

Brakes.....Westinghouse high-speed
Brake-beams.....Buffalo Brake-Beam Co.
Brake-shoes.....Diamond "S" flanged
Couplers.....Tower
Curtain fixtures.....Forsyth
Curtain material.....Pantasote
Door locks.....Boston & Maine standard
Draft gear.....Gould friction
Heating system.....Chicago, vapor
Lighting system.....Pintsch
Paint.....Boston & Maine standard
Platforms.....Gould
Roof.....Monitor; Boston & Maine standard
Seats.....Heywood Bros. & Wakefield Co.
Seat coverings.....Plush; Boston & Maine standard
Side bearings.....Boston & Maine, cast-iron
Springs, body.....Quintuple
Springs, equalizer.....9 in. x 11 in., 3 colls
Trucks.....Four-wheel; Commonwealth
Ventilators.....Globe, for lamps only
Wheels.....Midvale steel tires
Window fixtures.....Edwards

The *Delaware, Lackawanna & Western* has ordered from Barney & Smith six broad vestibule coaches, 15 suburban coaches and five combination passenger and baggage cars. The vestibule coaches will have a capacity of 72 passengers and will weigh about 87,000 lbs. They will be 59 ft. 1 in. long, 8 ft. 10 in. wide, and 9 ft. 7 in. high, inside measurements, and 67 ft. 10 in. long, 10 ft. 3/4 in. wide, and 14 ft. 3 1/4 in. high, over all. The suburban coaches will have a capacity of 78 passengers and will weigh about 79,000 lbs. They will be 59 ft. 9 1/2 in. long, 8 ft. 10 in. wide and 9 ft. 7 in. high, inside measurements, and 68 ft. 6 in. long, 10 ft. 3/4 in. wide and 14 ft. 3 1/4 in. high, over all. The combination passenger and baggage cars will have a capacity of 58 passengers, and will weigh about 74,000 lbs. The passenger compartment will be 44 ft. 6 in. long, and the baggage compartment 15 ft. long, inside measurements. The cars will be 8 ft. 10 in. wide and 9 ft. 7 in. high, inside measurements, and 68 ft. 3 in. long, 10 ft. 3/4 in. wide and 14 ft. 3 1/4 in. high over all. All of the cars will have wooden bodies and underframes and the following special equipment:

Axles.....Rehammered iron; Journals, 5 x 9 in.
Bolsters, body, Double cast-steel; Commonwealth Steel Co.
Bolsters, truck.....Sandwich
Brakes.....Westinghouse
Brake-shoes.....Long Streeter, with steel backs
Brasses.....Magnus metal
Couplers.....Gould
Curtain fixtures.....Forsyth automatic
Curtain material.....Pantasote
Draft gear.....Miner tandem
Heating system.....Gold, direct steam
Journal boxes.....Pullman pattern
Paint.....D. L. & W. standard
Platforms.....Standard Steel Co., broad vestibule
Seats.....B. & S. No. 35K
Seat covering.....Chase, crimson plush
Springs.....Railway Steel-Spring
Trucks.....Four-wheel
Ventilators.....Automatic
Vestibules.....Pullman type
Wheels.....Boles No. 2.

The broad vestibule coaches will have the following additional special equipment:

Lighting system.....Pintsch gas
Vestibule diaphragms.....Acme
Vestibule trap doors.....O. M. Edwards, steel
Window fixtures.....O. M. Edwards

The other two kinds of cars will have the following additional special equipment:

Lighting systems.....Commercial Acetylene Co.
Window fixtures.....National Lock Washer Co.

The Marquette County Gas & Electric Co., Ishpeming, Mich., is said to have ordered three coaches from the Niles Car & Manufacturing Co. This item is not yet confirmed.

The International & Great Northern specifications, published in the *Railroad Age Gazette* of July 17, should have included the body and truck bolsters, which will be furnished by the Scullin-Gallagher Iron & Steel Co.

IRON AND STEEL.

The Mexican Central has ordered 11,000 tons of rails from the Maryland Steel Co.

The Cazenovia & Sauk City is in the market for 60-lb. rails. See Railroad Construction columns.

The Lake Erie Traction Co., Westfield, N. Y., has asked bids on 1,200 tons of structural steel for building a viaduct.

The Chicago, Burlington & Quincy has ordered 250 tons of structural steel from the Toledo-Massillon Bridge Co. to be used in track elevation in Chicago.

The Isthmian Canal Commission has ordered from the United States Steel Products Export Co. 200,000 tie plates for 70-lb. rails, bids for which were received until June 2. The contract price was \$12,739.

The Chicago, Milwaukee & St. Paul, mentioned in the *Railroad Age Gazette* of July 17, has awarded the contract for 660 tons of structural steel for a drawbridge over the Chicago river to the Wisconsin Bridge & Iron Co.

The Chicago & North-Western has placed contracts for the 2,950 tons of structural steel for which it recently asked prices. The American Bridge Co. will furnish 2,200 tons of miscellaneous bridge steel and the Pennsylvania Steel Co. 750 tons for the North-Western's new terminal station at Chicago.

The receivers of the Milliken Bros. Steel Co., New York, have been ordered to pay the semi-annual interest due August 1 on the \$3,000,000 6 per cent. bonds. The extension of the receivership expires August 1, and it is thought that the plan of reorganization will be ready by that date, or shortly after.

RAILROAD STRUCTURES.

DOUGLAS, GA.—The Augusta Construction Co., G. B. Hazlehurst, Chief Engineer, Douglas, Ga., will receive bids until August 13 for the construction of the substructure and trestle approaches of the bridge across the Altamaha river, Georgia, on the line of the Georgia & Florida Railway, now under construction between Hazlehurst, Ga., and Vidalia. The work will comprise the founding and building of six concrete piers and about 3,000 ft. of timber trestle approach.

EAST SYRACUSE, N. Y.—The New York Central's 20-stall roundhouse, contract for which has been let to Marcellus & Ballard, as mentioned in the *Railroad Age Gazette* of July 24, will cost, it is said, \$135,000.

EUNICE, LA.—The Chicago, Rock Island & Pacific and the St. Louis & San Francisco will build a new passenger station here to cost \$25,000. Plans and specifications for the building have been prepared and work will begin about August 1.

GALVESTON, TEXAS.—The Texas Railroad Commission has been advised of the building of a causeway across Galveston bay. The county of Galveston voted bonds for building the proposed structure some time ago, but there has been delay because, it is said, of the slowness of the railroads in agreeing to the terms proposed for their use of the causeway. The Santa Fe and the Southern Pacific have agreed to enter into a preliminary contract with the county for the construction of the causeway, and it is announced that some similar action will soon be taken by the other railroads entering Galveston. The causeway will be used not only by steam railroads, but also by the proposed Galveston-Houston Interurban, and as a roadway for vehicles and foot passengers. (July 17, p. 549.)

LEXINGTON, KY.—The Lexington & Interurban is having plans prepared for a new car barn, 100 ft. x 200 ft. The build-

ing will have frame work of steel. The erection of a new power house is also being considered by the company.

LEWISTOWN, IDAHO.—The Northern Pacific has let the contract for a new depot to a St. Paul firm. Work will commence as soon as material and equipment can be assembled. The building will cost approximately \$75,000, and is to be completed before January, 1908. The structure will have office rooms on the second story.

LOWELLVILLE, OHIO.—The Baltimore & Ohio is said to be preparing plans for new car shops to handle repair work on the lines west of Pittsburgh. It is likely that the work will be started this fall.

MOUND VALLEY, KAN.—The Missouri, Kansas & Texas will erect a new depot at this place to replace the one burned some time ago.

TACOMA, WASH.—Local press despatches say that the Chicago, Milwaukee & St. Paul has decided to build large car shops here, and that repairs and new work for the western end of the road will be handled in the new shops.

The company's general office building here, it is said, will cost between \$300,000 and \$500,000. The present value of the real estate is estimated at \$100,000. (R. R. G., April 19, p. 564.)

WASHINGTON STATIONS.—The Railroad Commission of Washington issued orders to the Great Northern on July 18 to erect stations at the following places: Irby, Lamona, Krupp, Waukon, Winchester and Malaga.

SUPPLY TRADE NOTES.

The Zelnicker Crayon Works, St. Louis, Mo., has made Harmon & Dixon, 117 Chambers street, New York, exclusive agents for its line of crayons for New York and contiguous territory. A full stock of the Zelnicker line will be carried by them.

The Allis-Chalmers Co., Milwaukee, Wis., has an order from Worth Brothers Co., Coatesville, Pa., for three vertical blowing engines of the largest type ever built, to furnish the blast for new furnaces now in course of erection. The Sloss-Sheffield Iron & Steel Co., Birmingham, Ala., has ordered a blowing engine of similar type for immediate delivery.

The Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., is supplying the new electrical machinery for the Compania de Transvias y Fuerza de Guadalajara, Mexico. The company has bought a 750 K. V. A. Westinghouse three-phase, belted type generator to be installed at Juanacatlan. This generator is one of four which will be installed as needed.

A. V. Kaiser & Co., Philadelphia, Pa., are in the market for a large second-hand Worthington compound duplex condensing water-works pump, with a high-pressure cylinder 25 in. in diameter; low-pressure cylinder, 43 in.; plungers, 17½ in.; stroke, 36 in.; suction, 20 in.; discharge, 18 in.; capacity, 3,000,000 to 3,500,000 gallons. The pump should work against a pressure of 135 to 140 lbs.

The Page-Storms Drop Forge Co., Chicopee, Mass., is now in its new plant at Chicopee, combining the business of the factories heretofore operated at Springfield, Mass., and Chicopee Falls. By combining the two shops, the management is in a better position to give close personal supervision to the details of the business. The new plant is of modern construction and will continue to manufacture high grade forgings, thumb screws, nuts, etc.

Compagnie J. G. Brill, 14 Place de Laborde, Paris, has been organized to handle the business of the J. G. Brill Company, Philadelphia, Pa., in France and Spain, formerly cared for by Jacques Worms, 97 Rue de Courcelles. Brill trucks and equipment have been largely used for a number of years in Paris and throughout France and Spain. A plant is to be established and trucks will be built under French supervision by French workmen and machinery. The Brill No. 21-E type truck is in general use wherever four-wheeled cars are operated, and the Maximum Traction and short-base pivoted

trucks are well represented in Paris and other large cities. The high-speed truck of the No. 27-E type is in service on lines running out of Paris. The foremost French truck builders have followed the practice of using the solid-forged side frames common in the construction of all types of Brill trucks.

TRADE PUBLICATIONS.

Motors.—Bulletin No. 105 of the Crocker-Wheeler Co., Am-
pere, N. J., describes polyphase induction motors. Illustrations of a number of installations are included.

Steam Shovels.—The July issue of *Steam Shovel News* has an article by Wilmar Waldo, C.E., entitled "The Economy in Steam Shovel Plants"; also an article on "Tunnels in New York."

Tool and Die Steel.—The July stock list issued by Lawson & Simmons, Chicago, contains a list of the McInnes tool and die steel products on hand at the firm's warehouse. These bulletins are to be issued monthly.

Vertical Engines.—The American Blower Co., Detroit, Mich., has issued Catalogue No. 232, superseding No. 206, which fully describes its vertical, enclosed, self-oiling engines. The 64 pages of descriptive matter and illustrations give a comprehensive idea of Types A and E.

Metal Shingles.—A three-page folder is being distributed by the Milwaukee Corrugating Co., Milwaukee, Wis., describing the "Titelock" metal shingles, and advancing reasons why this shingle is the best roof covering. Several illustrations show the different types and sections manufactured.

Steam Shovels.—The Atlantic Equipment Co., New York, has issued a catalogue regarding its steam shovels. There are a large number of illustrations made in the course of construction work in which the Atlantic steam shovel was used. The pamphlet also has an article on the comparative efficiency of steam shovels.

Denver & Rio Grande.—"One hundred and seventy thousand opportunities and only 30,000 inhabitants to take advantage of them," is the way the passenger department of this road invites attention to the great possibilities for the farmer in its handsomely illustrated publication, "The Grand River Valley in Colorado."

Blowers.—A well illustrated and neatly printed catalogue of some 50 pages, descriptive of A. B. C. blowers for railroads, was recently issued by the American Blower Co., Detroit, Mich. This pamphlet describes and illustrates at some length the heating and ventilating of roundhouses, shops, car barns, depots and office buildings.

Kahn System of Reinforced Concrete.—The Trussed Concrete bulletin for July, published by the Trussed Concrete Steel Co., Detroit, Mich., gives some data as to the comparative shock resisting qualities of concrete structures and frame, brick and similar buildings, being a description of an explosion occurring in a factory building at Indianapolis, Ind.

Wood Preserving.—The open tank and brush treatment for the preservation of wooden ties, timbers, piles, etc., is fully described and illustrated in Bulletin 30, published by the Carbolineum Wood Preserving Co., New York. The pamphlet includes an article on the open tank treatment for preserving ties and cross-arms, reproduced from the *Street Railway Journal*.

Riveters, Punches, etc.—The Hanna Engineering Works, Chicago, announces that it has acquired the entire riveting business of the Quincy-Manchester-Sargent Co., Plainfield, N. J., including its full assortment of Pedrick & Ayer hydro-pneumatic, plain toggle American riveters, pneumatic punches, etc. A folder illustrates and describes some of the various riveters which the company manufactures.

Enclosed Arc Lamps for Mills and Factories.—The General Electric Co., Schenectady, N. Y., describes in Bulletin No. 4,603 an arc lamp specially suited to the illumination of mills and factories, where the vibration caused by machinery and the variation in line voltage resulting from the use of motors

for machine drive, render the ordinary arc lamp unsatisfactory. The lamp described is of the multiple type and is for use on 220-volt d.c. circuit.

Spiral Riveted Pipe.—Pamphlet No. 22 of the American Spiral Pipe Works, Chicago, calls attention to the different uses for which Taylor's spiral riveted pipe is adapted. The publication contains many illustrations, one of which shows a 12-in. pipe after bursting test, in which the portion adjacent to the seam was considerably bulged, while the seam itself remained practically unaffected. The company also makes forged steel flanges for every class of work.

Ball Bearings.—The Hess-Bright Manufacturing Co., Philadelphia, Pa., on sheet 22 of Series 336, gives curves of relative efficiency tests of a 3-h.p. motor mounted on regular oiling bronze bearings compared with the same motor mounted on ball bearings. Another curve compares current costs, while another shows the saving resulting annually through the substitution of ball bearings for regular ring oilers. Sheet No. 21 describes a design of automobile hub and steering knuckle.

Heavy Shop Tools.—The *Progress Reporter* for July, published by Niles-Bement-Pond Co., New York, illustrates and describes a number of very large and heavy shop tools, including a combination slotting, boring, drilling and milling machine; a 16-25-ft. heavy pattern extension boring and turning mill; a 60-ft. forge lathe; a 48-in. engine lathe; a 30-in. horizontal milling machine, a locomotive mounted fluting machine and smaller Pratt & Whitney machines. A detailed description of the spline milling machine is given in this issue of the *Railroad Age Gazette*.

Designing Methods for Reinforced Concrete.—The July number of the monthly bulletin being published by the Expanded Metal & Corrugated Bar Co., St. Louis, Mo., on designing methods for reinforced concrete construction, discusses special problems met with in the design of highway bridges and culverts. Detail designs are given of a flat slab bridge, box culvert and girder bridge, illustrating the application of the methods suggested. The August bulletin will contain standard designs for flat slab bridges, box culverts and girder bridges for the three classifications adopted for loading.

Wrecking Cranes.—The Industrial Works, Bay City, Mich., has issued catalogue U, devoted exclusively to railroad cranes for construction and wrecking. Cranes of different sizes, ranging from the heavier types having a capacity of 100 tons to the lighter cranes of 15 tons, are fully described and each is illustrated by a full page cut. The variety of uses to which these cranes have been put are well told in nine pages of illustrations showing the cranes clearing tracks after a wreck. On the last page of the catalogue are 134 names of railroads, being a partial list of the roads using Industrial cranes.

Cost of the National Transcontinental Railway.

A statement and a counter statement made in the Canadian House of Commons by R. L. Borden and G. P. Graham, Minister of Railways, regarding the cost to Canada of the construction of the Transcontinental Railway, show widely different estimates. Mr. Borden's statement was as follows:

Construction from Moncton, N. B., to Winnipeg, Man.	\$114,393,765
Interest during construction	10,009,454
7 years' interest after completion for which the G. T. P. pays no rent	26,124,676
3 years' additional interest for which no rent is to be paid unless the earnings are sufficient	11,196,290
Quebec Bridge, claimed to be an essential part of the railroad, cost to date	5,422,238
Quebec Bridge, estimated cost to complete	9,000,000
Share of terminals and shops east of Winnipeg	5,470,000
Amount guaranteed for Mountain section	46,140,000
Interest on bonds so guaranteed	9,689,000
Prairie section bond issue guarantee	11,908,000
Total	\$249,353,423

The estimate of the Minister of Railways in reply shows:

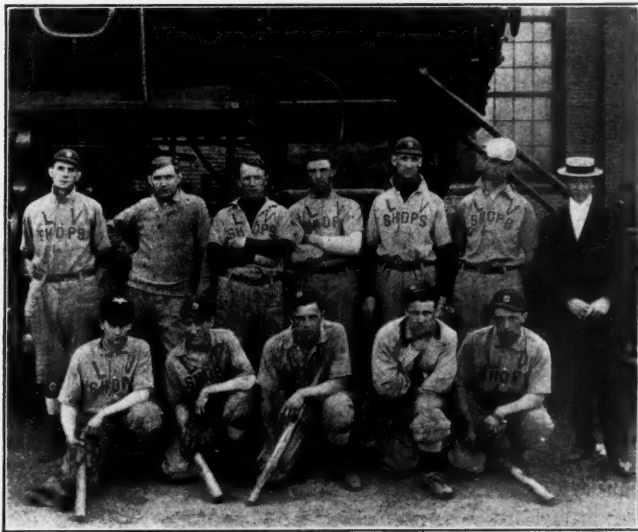
Construction, Moncton to Winnipeg	\$114,393,765
Interest during construction	10,009,454
7 years' interest after completion	26,124,676
Share of terminals	3,500,000
Total	\$154,027,895

In the latter estimate, the allowance for three years' interest

in the event of no rent being received on account of the receipts being insufficient has been struck out. The items relating to the Quebec Bridge are not included, as although the bridge is admitted to be an integral part of the railroad scheme, it is felt that it should be treated as a separate affair. The share of cost of terminals mentioned in the first estimate is also considerably reduced. The Minister claimed that the country would never be called on to pay anything on the guarantee of the Prairie section bond issue.

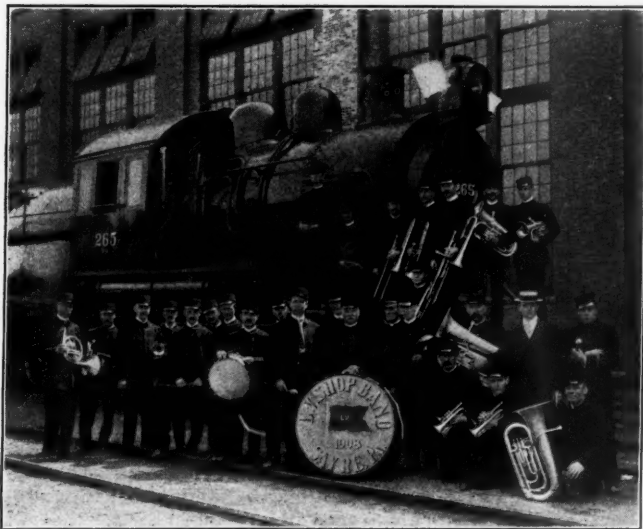
The Sayre Band and Ball Nine.

During the past 18 months, a baseball nine and a band have been organized at the Lehigh Valley shops at Sayre, Pa., and in the same period the output of the shops has been more than doubled, although the appropriation has been reduced



The Sayre Shops Baseball Team.

nearly 30 per cent. All departments used to hang together, and Sayre was known as a "hard" place. The band and the ball nine have changed all this. When a few hot-headed boilermakers made a little trouble, last March, they got no sympathy from the other departments—the band and the ball nine won the day! The shops do no work Saturday after-



The Sayre Shops Band.

noons, and the nine always has a game, accompanied by the band. The superintendent thinks that the value of these aids to harmony and industrial efficiency is not as well known as it ought to be. He believes in having everybody around a shop happy!

International Acetylene Association.

The eleventh annual meeting of the International Acetylene Association will be held at the Auditorium Hotel, Chicago, on August 10, 11 and 12. Papers, discussions and reports of committees will be presented by members prominent in the acetylene industry and are intended to be quite interesting and valuable. The committee on arrangements has provided a program designed to develop the social side of the meetings; and the ladies are cordially invited to attend. Hotel reservations and program details may be secured from A. Cressy Morrison, Secretary, 157 Michigan avenue, Chicago.

United States Pig Iron Production.

The *Bulletin* of the American Iron and Steel Association for August 1 gives as the production of pig iron in the United States in the first half of 1907, 13,478,044 gross tons; for the second half of 1907, 12,303,317 tons, and for the first half of 1908, 6,918,004 tons.

The total production by states for the first half of the present year is given in the following table:

States.	Blast furnaces				Production.		
	In blast June 30, 1908.				Gross tons of 2,240 lbs.*		
	Dec. 31, 1907.	In.	Out.	Total.	First half, 1907.	Second half, 1907.	1st half, 1908.
Massachusetts ..	2	0	2	2	8,746	10,373	5,220
Connecticut	3	2	1	3			
New York	9	8	18	26	859,125	800,627	376,208
New Jersey	5	2	9	11	195,245	177,944	125,143
Pennsylvania	70	61	99	160	5,964,884	5,383,665	3,032,297
Maryland	1	2	3	5	221,145	190,688	82,785
Virginia	7	9	17	26	260,912	217,859	137,356
Georgia	1	1	3	4			
Texas	0	1	3	4	26,173	29,652	5,260
Alabama	15	20	31	51	861,771	824,903	605,617
West Virginia ..	0	1	3	4	151,643	139,423	27,901
Kentucky	1	2	6	8	79,013	48,933	21,357
Tennessee	9	10	11	21	193,371	199,735	115,249
Ohio	17	23	46	69	2,815,174	2,435,513	1,209,399
Illinois	11	14	11	25	1,263,258	1,194,510	782,865
Indiana	1	1	0	1			
Michigan	8	5	8	13	197,330	239,177	167,063
Wisconsin	2	2	5	7			
Minnesota	1	0	1	1	160,045	162,038	69,303
Missouri	1	2	0	2			
Colorado	3	2	4	6			
Oregon	0	0	1	1	220,209	248,277	154,981
Washington	0	0	1	1			
California	0	0	0	0			
Total	167	168	283	451	13,478,044	12,303,317	6,918,004

*Includes spiegeleisen and ferro-manganese.

The total production of all kinds of pig iron from 1903 to 1907, inclusive, was as follows:

States.	Production. Gross tons of 2,240 lbs.				
	1903.	1904.	1905.	1906.	1907.
Massachusetts ..	3,265	3,149	15,987	20,239	19,119
Connecticut	14,501	8,922			
New York	552,917	605,709	1,198,068	1,552,659	1,659,752
New Jersey	211,667	262,294	311,039	379,390	373,189
Pennsylvania	8,211,500	7,644,321	10,579,127	11,247,869	11,348,549
Maryland	324,570	293,441	332,096	386,709	411,833
Virginia	544,034	310,526	510,210	483,525	478,771
No. Carolina ..					
Georgia	87,255	75,686	38,699	92,599	55,825
Texas					
Alabama	1,561,398	1,453,513	1,604,062	1,674,848	1,686,674
West Virginia ..	199,013	270,945	298,179	304,534	291,066
Kentucky	102,441	37,106	63,735	98,127	127,946
Tennessee	418,368	302,096	372,692	426,874	393,106
Ohio	3,287,434	2,997,929	4,586,110	5,327,133	5,250,687
Illinois	1,692,375	1,655,991	2,034,483	2,156,866	2,457,768
Indiana	244,709	233,225	288,704	369,456	436,507
Michigan	283,516	210,404	351,415	373,323	322,083
Wisconsin					
Minnesota					
Missouri					
Colorado	270,289	151,776	407,774	413,040	468,486
Washington					
California					
Total	18,009,252	16,497,033	22,992,380	25,307,191	25,781,361

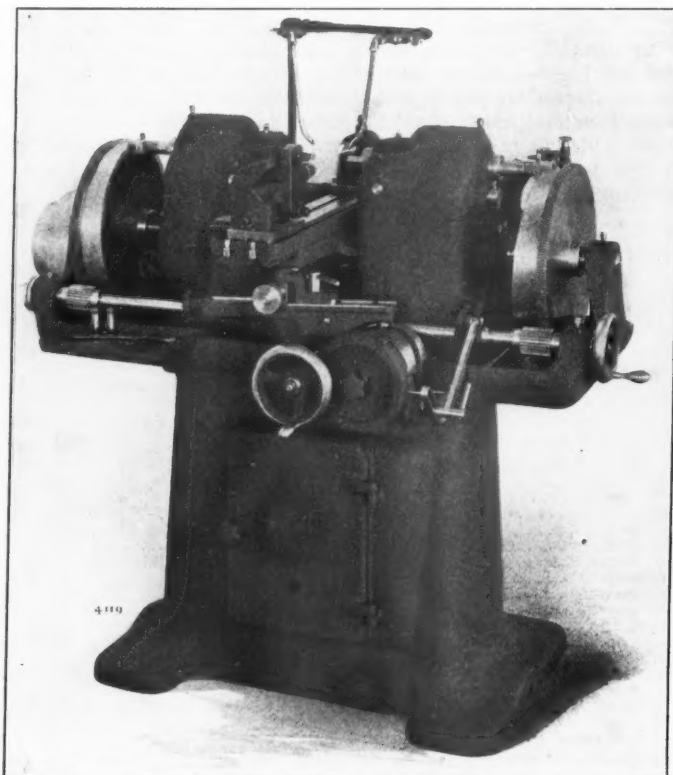
Meeting of Engineers of Harriman Lines.

A meeting of the chief engineers and other maintenance officers of the Harriman Lines was held at Denver, Colo., from July 20 to July 24. At this meeting standard specifications for steel work for structures other than bridges were adopted; engineering and maintenance of way rules were revised; engineering and maintenance of way blanks for the entire system were standardized so as to be uniform for all lines and a large number of blanks were abolished; plans and specifications were adopted for minor track tools, and various railroad appliances and apparatus were approved. This meeting was presided over by John D. Isaacs, Consulting Engineer of the

Harriman Lines, and the various railroads interested were represented by their chief engineers and maintenance officers.

Spline Milling Machine.

Designed particularly for milling slots with closed ends, the spline milling machine, made by the Pratt & Whitney Co., Hartford, Conn., is well adapted to a large variety of work, as shown in the accompanying illustration. The machine has a stiff, compact frame, the two cutter heads being cast integral with it. The work-carrying slide traverses back and forth between the two cutter spindles, which at the end of

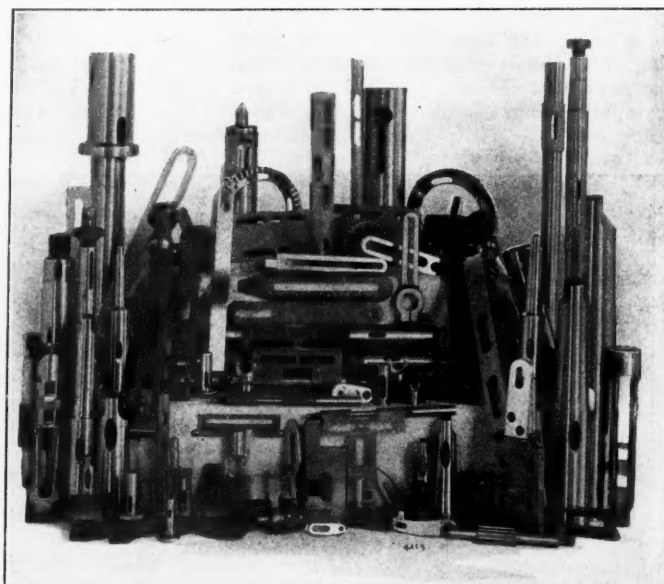


Spline Milling Machine.

each stroke automatically feed toward each other. Care has been taken in the design of this machine to obtain rigidity, thus preventing chattering, and to conveniently place all adjusting levers and hand-feed wheels. The cutter spindles are of steel, hardened and ground to receive Pratt & Whitney No. 3 bench lathe draw-in collets. The spindles run in bronze bearings, the front bearing sliding with the spindle. By a weight and cable wound around a shaft pinion which engages with a rack on the bearing, the spindles are held back so that their outer ends are retained in contact with the large edge cams. These cams are adjustable in and out on the shaft by means of two annular nuts. On the periphery of the cams are graduations which are used as a guide in setting for depth of cut. The cutter spindles are driven by a three-grade cone through gearing enclosed within the frame, and the gears are easily accessible for oiling or removal. With the two-speed counter regularly supplied, six spindle speeds are obtainable. The cutters run in opposite directions so that right-hand cutters are suitable for both spindles. The cutter spindles may be operated independently or simultaneously, and where a slot is not required entirely through the work or on each side, it is found economical to adapt the work-holding fixture to receive two pieces of work and to mill a slot in each piece at the same time. In the case of tang slot milling, the cutters enter from opposite sides, one cutter being advanced ahead of the other, so that they do not meet in the center. The one finishing the extent of its travel first returns to its starting position, while the other continues through the center web, leaving the slot clean. This spindle, after completing its cut, returns to its initial position. The angular adjustment to

the edge cams, which causes the cutters to finish at different times, is effected by sliding the driving pinion to one side and rotating the cam, then putting the pinion back into mesh with the gear teeth on the edge cam. The cutting action of the cutters used is entirely in end, and when once started has no tendency to widen the slot, but leaves the cut straight, smooth and of exact size. The table is traversed automatically in both directions by a constant cam, shown in the illustration, operating a rocker arm, to which is connected a long link which is connected to the under side of the table. The connection for the link operating the table slides in a T slot and any desired travel of the table up to 4 in. may be obtained. A scale is provided for quickly and accurately determining the correct position of the connection. The link is long, extending through the machine, and is attached to the table at the rear end, thus avoiding any tendency to cramp when working under extreme angular conditions. The table has adjustment for position without altering the stroke, or amount of travel; this is accomplished by changing the length of the link. This allows the table, together with the work, to be moved in relation to the cutters $1\frac{3}{4}$ in. without releasing the work-holding device.

The hand-wheel shown affords a means of traversing the table by hand, while the knob directly to the right engages the power feed by means of a cone friction disc. As the link connection is adjusted from zero, the greater the table travels in a given time, and to compensate for this, five changes of the power-feed shaft are provided. Thus the rate of table feed may be kept constant, or changed to any rate required. The feed changes are accomplished by movement of a sliding key, which engages with one of the five sets of gears enclosed in the column. The index pin and dial is placed directly in the rear of the right-hand cutter spindle. The contour of the table cam is such as to cause the table to stop at each end of its stroke, while the cutter spindles are fed forward by a partial rotation of the large edge cams. These cams have gear teeth cut entirely around their periphery and are in mesh with pinions keyed to the long cross shaft. The automatic feed is through an adjustable link motion, commonly used on shapers and planers. The link motion is operated by a two-lobe cam which is cast integral with the table-feed cam, so as to insure the intermittent feed-



Work Done on Spline Miller.

ing action to take place at the time the table is not in motion. When taking deep cuts, especially on steel, with the two-lipped fish-tail cutter, the feed obtained by one tooth on the ratchet is recommended. For steel and cast-iron where slots are not deep, a feed of two teeth may be safely used on steel and three or more teeth on cast-iron. When three or four lipped cutters are used on steel work, a feed of three or four teeth will give good results.

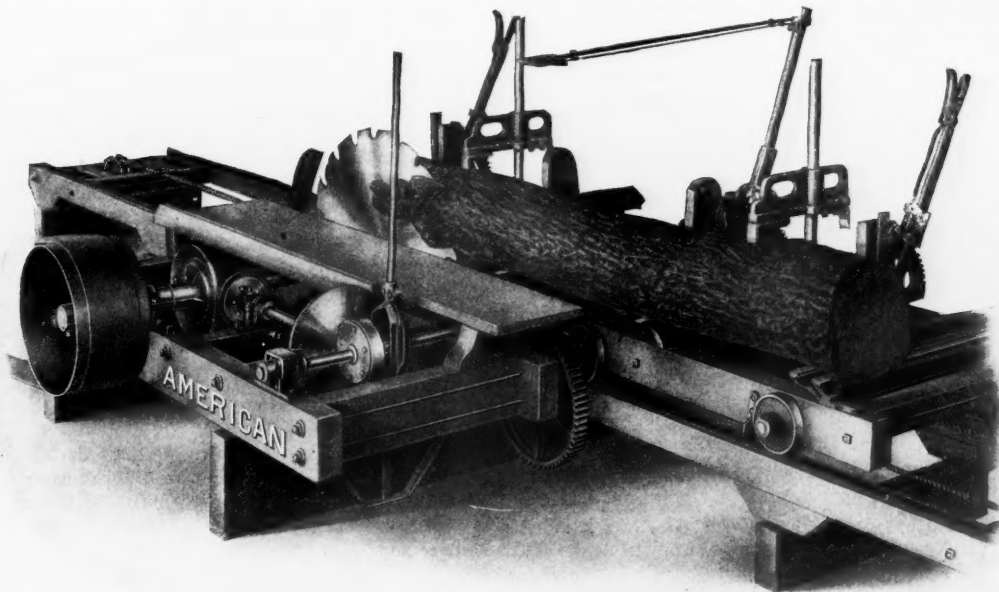
A rotary pump is regularly furnished with the machine,

insuring a liberal supply of lubricant to cool the cutters and to carry away the chips. Lubricating and cooling compounds such as "Harvyline" will be found much superior to oil in effectively keeping the cutting edges cool. Such compounds are particularly superior in that they rapidly wash away the chips, which is essential in the production of work with clean, smooth slots. In order to keep the lubricant cool, a large tank is provided. This tank is fastened to the door inside of the frame, and by opening the door, easy access to the tank for purposes of replenishing, cleaning, etc., is afforded. The machine is regularly furnished with universal vise and center for holding round stock, four draw-in collets (two

sary to remove the work from the jaws, the vise itself being swiveled on the base without touching the screw or lever and held in position by a turn of the tightening studs.

American Tie Mill.

To meet the demand for a saw mill of rapid action that can be operated by light power and produce a large number of ties at minimum cost, the American Saw Mill Machinery Co., Hackettstown, N. J., has put on the market the short-log, or tie mill, shown in the accompanying illustration. This machine is strongly built of select material and each one is

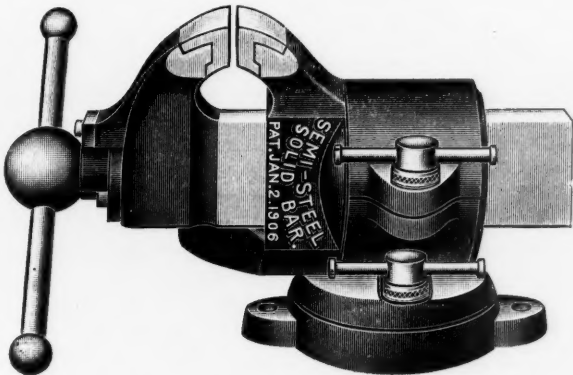


American Tie Mill.

each, $\frac{1}{4}$ in. and $\frac{7}{16}$ in.), oil pump, tank and piping, two-speed countershaft and wrenches. Motor drive may be readily applied if desired.

Parker Double Swivel Vise.

The accompanying illustration shows one of the series 429 double swivel vises made by the Charles Parker Co., Meriden, Conn. These vises are made with patented reinforced sliding jaw, consisting of a solid bar inserted the entire length



Parker Double Swivel Vise.

of the slide. Being welded into the casting, the bar renders the slide, or movable jaw, practically unbreakable. This feature, and also the solid under portion of the front jaw, or slide, are distinctive features of all vises of this make. Made of a mixture of cast iron and bessemer steel, the Parker vise is guaranteed to be of great strength and durability. The jaw faces, made of tool steel, are milled and fitted to the jaws, so that they can be renewed at any time. Another valuable feature of this vise is its double swivel, making it unneces-

carefully tested to a speed of 1,050 r.p.m. before shipment. It can be successfully operated by any amount of power from 6 h.p. to 20 h.p. and is said to have a record of 1,200 mine ties in 10 hours with a 15-h.p. engine and two operators. The mill consists of a Husk frame 7 ft. long by 3 ft. wide, of timbers $3\frac{1}{2}$ in. x $7\frac{1}{2}$ in. The mandrel is $2\frac{3}{8}$ in. in diameter, carrying saws from 30 in. to 54 in. in diameter, with a 20-in. x 10-in. pulley. The variable friction feed and rapid gig back of the carriage adapts the machine to use with small or large power and to all classes of work. The carriage is made in one section 8 ft. long and 30 in. wide, with three trucks having $1\frac{1}{4}$ -in. axles and 7-in. wheels with self-oiling bearings. The carriage equipment consists of two simultaneous ratchet head blocks connected by a log beam, two dummy head block bases, two dummy and two taper sawing knees, two drop dogs with the Ideal ratchet set works, having a quick receding device. The track is of special rolled steel. The carriage is provided with a simple but effective cable drive giving a stroke varying from 2 ft. to 16 ft. The total weight of the equipment, including track ways and foundation timbers, is about 3,800 lbs.

Sales of Small Curtis Turbines.

A partial list of small Curtis steam turbines under 500-k.w. capacity which up to the present time have been installed by the General Electric Co., Schenectady, N. Y., or are under construction, shows that of 570 odd turbines, representing a total capacity of about 37,000 k.w., 7 per cent. are for the export trade. The remainder are for domestic service in central stations, marine work, laboratories, power and lighting plants for hotels, office buildings and ships, laundries, mines, printing establishments, etc. Among the widely different industries in which these small turbines are used, are wood-working plants, foundries, iron and steel mills, distilleries, chemical plants, ice plants, textile mills, breweries, tanneries, flour mills, shoe factories, paper mills, machine shops, textile mills and ammunition manufacturing plants. Turbines for

train lighting are also finding a ready market. The latest application of moderate size Curtis turbines is for driving fire pumps.

International Association for Testing Materials.

The fifth congress of this association is to be held early in September in Copenhagen, Denmark. The association is represented in this country by the American Society for Testing Materials. The proceedings of the congress will consist largely of official reports of standing committees and individual referees on scientific subjects relating to the testing of materials. Non-official papers by members of the association will be presented at this congress on metals, hydraulic cements and other subjects.

The office of the General Secretary of the International Association is at 11 Nordbahnstrasse 50, Vienna, Austria. Edgar Marburg is Secretary of the American Society for Testing Materials, University of Pennsylvania, Philadelphia, Pa.

Railroad Officers.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

W. T. Chisholm, Chief Assistant to H. B. Chamberlain, Vice-President of the Erie, has resigned to go to the Boston Dining Car Co.

J. Welch has been appointed Auditor of the Montana Railroad, with office at Helena, Mont., succeeding F. W. Sharpe, resigned.

The names of the officers to be elected for the new Denver & Rio Grande Railroad Company will be found in Railroad Financial News.

Carl Rasch has been appointed Secretary of the Montana Railroad, with office at Helena, Mont., succeeding T. A. Mapes, who continues to be Treasurer.

John B. Munson has been elected Vice-President of the Georgia Southern & Florida, with office at Macon, Ga., succeeding S. F. Parrott, resigned.

E. N. Brown, President of the National Railroad of Mexico, has been elected also President of the National Railways of Mexico.

The offices of J. F. Hanson, President of the Central of Georgia, and of C. C. Williams, Secretary, will be moved on August 1 from Macon, Ga., to Atlanta.

C. T. Williams, whose resignation as Secretary and Treasurer of the Raleigh & Charleston has been announced in these columns, has been appointed Secretary to the Receivers of the Seaboard Air Line, with office at Baltimore, Md.

The appointment of B. A. Dousman as Assistant General Auditor of the Chicago, Milwaukee & St. Paul, recently announced in these columns, means that there are now two Assistant General Auditors, W. F. Dudley remaining an Assistant General Auditor.

Operating Officers.

H. H. Brewer has been appointed Superintendent of the Lake Superior division of the Grand Trunk Pacific, with headquarters at Westford, Ont.

The office of R. M. Leech, Superintendent of the Southern division of the National Railroad of Mexico, has been moved from Mexico City to Queretaro, Quer., Mex.

T. H. Williams, formerly Superintendent of car service of the Indiana Harbor Belt, is now Train and Station Inspector of the Southern Pacific at San Francisco, Cal.

John M. Rapelje, Superintendent of the Northern Pacific at Glendive, Mont., has been appointed Superintendent at Missoula, Mont., succeeding F. E. Willard, resigned.

F. L. Lewis, Superintendent of the San Antonio & Aransas Pass, has been appointed Assistant General Manager, succeeding F. C. Smith, resigned to engage in other business.

Traffic Officers.

S. M. Wilcox has been appointed Traveling Agent, Foreign Department, of the Erie at Chicago.

Charles H. Trimble, Commercial Agent of the Atlantic Coast Line at Cincinnati, Ohio, has been transferred to St. Louis, Mo.

R. G. Thompson has been appointed District Passenger Agent of the Wabash at Indianapolis, Ind., succeeding George D. Maxfield, promoted.

John W. Williams, Passenger and Freight Agent of the Lehigh Valley at North Tonawanda, Pa., has resigned to take a western trip for his health.

Frank L. Moe, Commercial Agent of the National Railroad of Mexico at St. Louis, Mo., will hereafter represent both that road and the Mexican Central.

G. J. Noeller, Traveling Passenger Agent of the Toledo, St. Louis & Western and the Chicago & Alton at Buffalo, N. Y., has resigned to engage in other business, effective July 31.

Charles W. Ten Broeck, Foreign Freight Agent of the Delaware, Lackawanna & Western at New York, has resigned, effective September 1, to go to A. H. Post & Co., New York, freight forwarders.

C. D. Whitney, formerly General Traffic Manager of the Toledo, St. Louis & Western, has been appointed Assistant General Freight Agent of the Missouri & North Arkansas, with headquarters at Eureka Springs, Ark.

W. D. Cornell has been appointed Traveling Passenger Agent of the Chicago & Alton and the Toledo, St. Louis & Western, at Buffalo, N. Y., succeeding George J. Noeller, resigned. J. W. O'Brien has been appointed Traveling Passenger Agent of these lines at Pittsburgh, Pa. Both Mr. Cornell and Mr. O'Brien will report to R. J. McKay, Assistant General Passenger Agent at Chicago.

Engineering and Rolling Stock Officers.

J. J. Cozzens, Supervisor of Signals of the New York Central & Hudson River, has resigned.

F. K. Edwin has been appointed Superintendent of Bridges of the New York, New Haven & Hartford at Stamford, Conn., succeeding V. V. Wiggin, resigned.

H. H. Hale, Superintendent of Motive Power of the Nevada Railroad, has been appointed Master Mechanic of the Gulf & Ship Island, with headquarters at Gulfport, Miss., succeeding W. J. Haynen, resigned.

A new Roadmasters' district has been created on the Idaho division west of Pocatello on the Oregon Short line. Thomas Sinnott, Assistant Roadmaster of the Utah division, has been appointed Roadmaster of the Glenn's Ferry district, with headquarters at Glenn's Ferry, Idaho. Elmer Holt succeeds Mr. Sinnott.

Purchasing Officers.

B. G. Calloway has been appointed Purchasing Agent of the Tennessee Central.

OBITUARY.

Albert McLeod, Assistant General Freight Agent of the Cincinnati, Hamilton & Dayton, died on July 20 in Cincinnati, Ohio.

Frederick Dwight Raymond, Secretary and Treasurer of the Elgin, Joliet & Eastern and the Chicago, Lake Shore & Eastern, died of heart failure on July 18, at his home in Evanston, Ill. He was born September 16, 1852, at Wilbraham, Mass., and graduated at the Northwestern University at Evanston in 1872. He began railroad work in 1873 as paymaster of the Chicago & Paducah, now a part of the Wabash. He served consecutively as Assistant General Freight Agent of the Chicago & Paducah and of the Chicago, Pekin & Southwestern, now a part of the Santa Fe; cashier of the Wabash at Chicago; Auditor and paymaster of the Chicago & Indianapolis Air Line; General Freight Agent of the Chicago & Great Southern, now a part of the Chicago & Indiana Coal Ry.; Auditor of the Union Steel Co., at Chicago, and then took the position he held at the time of his death.

Railroad Construction.

New Incorporations, Surveys, Etc.

ARIZONA RAILROADS.—A press report from Flagstaff, Ariz., says that surveys are under way for a proposed railroad from Flagstaff southwest to Jerome, about 55 miles. Arthur Maguire, Las Vegas, N. Mex., is in charge of surveys.

ATLANTIC COAST LINE.—Local reports say that the steel and concrete bridge over the St. Mary's river, near Folkstown, Ga., is nearly completed, after which the work of double tracking between Folkstown and Callahan will be resumed. E. B. Pleasants, Chief Engineer, Wilmington, N. C.; T. S. Tutwiler, Engineer of Roadway, Savannah, Ga. (R. R. G., March 13, p. 389.)

BIRMINGHAM & GULF RAILWAY & NAVIGATION CO. (ELECTRIC).—Organized to build an electric line from Gadsden, Ala., southwest to Tuscaloosa, 120 miles; also to operate a line of steamers from Tuscaloosa to Mobile, Ala., and Gulf points. The company now has boats plying between Mobile and Montgomery, and between Mobile and Demopolis. (R. R. G., April 3, p. 492.)

CAZENOVIA & SAUK CITY.—An officer writes that contracts are shortly to be let for building the first section of the proposed line from Lavelle, Wis., south, via Ironton, to Cazenovia. It is expected to have this 10-mile section finished this fall. The line is projected south from Cazenovia, via Lineridge and Logansville to Sauk City, about 30 miles. Joseph Duren, Cazenovia, Wis. (July 10, p. 505.)

CENTRAL RAILWAY.—R. Macdonald, President of the Dominion Engineering Co., which company is said to hold the contract for building the line from Montreal, Que., to Midland, on Georgian Bay, is quoted as saying that active work will begin in the near future. Preliminary surveys have been made and options on several lines are held by the company. When completed, it is expected to become an important factor in carrying grain from the west.

CHICAGO, MILWAUKEE & ST. PAUL.—An officer is quoted as saying that the work on the coast extension has been pushed as rapidly as possible. At present there are about 2,000 laborers employed on this line in Montana. It is expected that the road will enter Butte, Mont., within two weeks. This extension is said to penetrate one of the most fertile sections of the state. (R. R. G., Jan. 17, p. 104.)

CHICAGO, ROCK ISLAND & PACIFIC.—It has been announced that this road is planning a cut-off from Mangum, Okla., southeast through western Texas, across the corner of New Mexico via Carlsbad, to El Paso, Texas. It is expected that the proposed line will run through Childress, Tex., Flaydada, Lubert and Brownfield. The new line is expected to shorten the time to Mexico from the northern states about seven hours.

GALVESTON & HOUSTON INTERURBAN.—See Galveston, Tex., under Structures.

GEORGIA ROADS (ELECTRIC).—James W. Mayberry, of Society Hill, Ga., has given the Columbus Board of Trade data regarding the territory through which it is proposed to build an electric line from Columbus to Society Hill, 30 miles. A special committee is to be appointed to investigate and report to the citizens of Columbus.

GRAND TRUNK PACIFIC.—Tenders will be received until August 20 by P. E. Ryan, Secretary of the Transcontinental Railroad Commission, Ottawa, Ont., for the construction of the following sections, which will complete the line between Winnipeg, Man., and Moncton, N. B.: From a point near Weymontachene, Que., westerly for a distance of 107 miles, to be completed by December 31, 1910, check \$150,000; from the western end of the above contract westerly for 114.97 miles, to be completed by December 31, 1910, check \$150,000; from the western end of Fauquier Bros. Abitibi contract westerly for 104.24 miles, to be completed by December 31, 1910, check \$150,000; from a point 60 miles west of the eastern boundary of district E westerly for 100 miles, to be completed by December 31, 1910, check \$150,000; from a point near Dog Lake, easterly for 126 miles, to be completed by September 1, 1910, check \$200,000, and from a point at or near

Dog Lake, Ontario, westerly for 23.76 miles by the northerly route, or 24.13 miles by the southerly route, to be completed by September 9, 1909, check \$100,000. Plans, profiles and specifications may be seen at the offices of the engineers at North Bay, Ont.; Nepigon, Ont., and St. Boniface, Man.

According to a statement made by D'Arcy Tate, solicitor for the company, the government has approved the entire route of this line from Edmonton, Alb., to the Pacific coast. The Copper river route has been abandoned.

GREAT NORTHERN.—Preliminary surveys are said to be under way for a line to connect the Great Northern, the Northern Pacific and the Spokane, Portland & Seattle. The proposed route is to extend from Adrain, Wash., the junction of the Great Northern and the central Washington branch of the Northern Pacific, southeast to Connell, a junction of the Northern Pacific and the Oregon Railroad & Navigation. The present Northern Pacific line between Connell and Pasco is to be used to connect the new line with the Spokane, Portland & Seattle at Pasco, Wash.

HARRISBURG & OHIO RIVER.—A press despatch from Harrisburg, Ill., says that this company's property and holdings, including the right of way, has been sold to satisfy creditors. A. J. Webber, of Galatia, Ill., bought it in trust for the stockholders. It is said that the company will be reorganized and construction work resumed. The branch now building will connect with the Illinois Central at Galatia, northeast of Harrisburg, and will extend to a point on the Ohio river. (R. R. G., March 15, p. 384.)

ILLINOIS CENTRAL.—See Harrisburg & Ohio River.

MEXICAN CENTRAL.—See Parrall & Durango.

MISSOURI, TENNESSEE & ALABAMA.—Proposed from Kansas City, Mo., via New Madrid, Dyersburg, Tenn., and Jackson, to Savannah, Ga., about 700 miles. J. L. Williams is said to be making a survey from Dyersburg to Jackson.

NORTHERN PACIFIC.—See Great Northern.

OREGON RAILROAD & NAVIGATION.—See Great Northern.

OUACHITA VALLEY CONSTRUCTION CO.—Incorporated in New Jersey with \$100,000 capital stock to build from Hot Springs, Ark., east to Meno, about 60 miles. G. E. Crater, Jr., G. H. Gilbert and F. S. Treadway, of New York, are the incorporators.

PARRALL & DURANGO.—El Paso, Tex., press reports say that work is being pushed on the Guanacevi extension, and that about 32 miles of the road from Mesa da Sandaia, Durango, have already been completed. It is expected that trains will be running to a point 95 miles from Parrall, Chihuahua, within a few months. This road when completed will open up a rich mining section in Durango and, it is said, will be a feeder for the Mexican Central, with a considerable amount of ore for the El Paso smelter. July 3, p. 457.)

ROCKPORT, LANGDON & NORTHERN.—It is said that contracts for construction of the Rockport, Shenandoah & Des Moines branch will be let in the near future. The W. K. Palmer Company, Kansas City, Mo., will, it is said, let the contracts for construction and also the bridge material. (R. R. G., May 1, p. 624.)

ST. LOUIS & SAN FRANCISCO.—The last of the four steel spans of the Beaumont, Sour Lake & Western bridge over the San Jacinto river, near the line of Harris county, Tex., is said to be completed. This steel bridge completes in permanent form the Frisco line from Opelousas, La., to Houston, Tex. Track is laid beyond the Atchafalaya river, so that the Frisco will run its trains over its own tracks from Houston, Tex., to New Orleans, La.

SOUTHERN PACIFIC.—An officer of the Texas & New Orleans is quoted as saying that bids for construction of the line from Galatian, Tex., south to Rusk, about eight miles, will probably be asked in a short time. (July 17, p. 555.)

SPOKANE, PORTLAND & SEATTLE.—See Great Northern.

TEXAS & NEW ORLEANS.—See Southern Pacific.

VANCOUVER ISLAND & EASTERN.—The company has received a Dominion Government subsidy for a 100-mile line from a point on the Esquimalt & Nanaimo branch of the Canadian Pacific near Campbell River north toward Fort George, B. C.

VANCOUVER, WESTMINSTER & YUKON.—This company has received a Dominion Government subsidy for a 100-mile line from Vancouver, B. C., north toward Fort George.

VIRGINIAN RAILWAY.—It is said that 155 miles of line from Norfolk, Va., to a point west of Meherrin has been completed, while about 50 miles of the section out of Brookneal and about 50 miles on the Roanoke section are also completed. The entire line is expected to be finished by January. (R. R. G., March 13, p. 395.)

Railroad Financial News.

ATLANTIC COAST LINE.—See Georgia Railroad & Banking Co.

BOSTON TERMINAL.—Damages of \$656,803 has been given to this company by the Superior Court at Boston, Mass., against the city of Boston. The city of Boston incurred the damages in the construction of the Cove Street bridge.

BUFFALO, ROCHESTER & PITTSBURG.—See Lake Shore & Michigan Southern.

CALUMET & SOUTH CHICAGO.—It is said that this company is to issue \$3,000,000 of an authorized issue of \$5,000,000 first mortgage 5 per cent. bonds of 1908-1927; only \$500,000 are to be offered for sale. At present the property of this company is subject to purchase by the city for municipal operation for \$5,000,000 plus expenditures made in rehabilitating it, and also plus 15 per cent. of such expenditures. The City Railway may buy the Calumet & South Chicago at 12 per cent. above the purchase price offered by the city, or, any other company may buy at 20 per cent. above the city's price.

CENTRAL NEW ENGLAND.—The general mortgage bondholders' committee has proposed an extension of the pooling agreement for one year from July 20, the bondholders to contribute 1 per cent. additional to the 1 per cent. they have already contributed for expenses. (R. R. G., Feb. 21, 1907, p. 260.)

CENTRAL PACIFIC.—This road has paid its twentieth note to the government. This note was for \$2,900,000 and its payment releases the remainder of \$18,000,000 Central Pacific bonds recently offered for sale. (July 24, p. 602.)

CHICAGO & MILWAUKEE ELECTRIC.—The report of Young & Co., accountants, has been filed by the receivers. It says in part: The company, with a bonded indebtedness of \$15,080,000 and a floating debt of \$2,169,100, has a property that cost, at the outside, \$8,111,324. The amount spent in construction, according to the certificates signed by the President and Engineer or Secretary, and given to the trustees of bonds, were as follows: Illinois division, \$4,302,500; Wisconsin division, \$9,998,400, a total of \$14,300,900. On the other hand, the amount spent on the entire property, as shown by the construction company's books, was \$8,082,630, including interest and passenger and freight earnings, capitalized amounting to \$1,340,873 ruled as improper.

CINCINNATI, HAMILTON & DAYTON.—The interest due July 1 on the \$2,000,000 second (now first) 4½ per cent. bonds of 1887-1937 having been defaulted, W. S. Rowe, Clifford B. Wright, Geo. H. Bohrer and Seasongood & Mayer have formed a protective committee and ask the deposit of bonds with the Union Savings Bank & Trust Co., Cincinnati, Ohio.

DENVER & RIO GRANDE.—At a meeting of the stockholders in Denver on July 23 it was voted to merge into one company, to be known as the Denver & Rio Grande Railroad Company, the present Denver & Rio Grande Railroad Company and the Rio Grande Western Railway Company and all subsidiary railroad companies in Colorado and Utah, excepting the Rio Grande Southern. The stockholders of the Rio Grande Western and its subsidiary companies had previously voted for the consolidation. The new company, it is said, will issue \$150,000,000 in bonds and \$88,000,000 in stock, the bonds to be used to retire the outstanding bond issues of the railroads amalgamated and the stock to be exchanged for outstanding stock of the present Denver & Rio Grande and Rio Grande Western companies. The rights of stockholders in the new company are to remain the same as were their rights in the old companies. Directors of the consolidated company were elected as follows: George

J. Gould, E. T. Jeffery, Winslow S. Pierce, A. H. Calef, Howard Gould, Edwin Gould, Arthur Coppel, C. H. Schlacks and Joel F. Vaile. It is announced that the directors at a meeting in New York will elect the following officers: President, E. T. Jeffery; Vice-President, C. H. Schlacks; Secretary, Stephen Little; Treasurer, J. W. Gilluly; General Counsel, Joel F. Vaile.

GEORGIA RAILROAD & BANKING CO.—This company has sold to Joseph Walker & Sons, New York, and John W. Dickey, Augusta, Ga., \$1,000,000 forty-year 4 per cent. debenture bonds of 1907-1947. These bonds are sold to refund an equal amount of 6 per cent. bonds due January 1, 1910. The property is jointly operated by the Louisville & Nashville and the Atlantic Coast Line, under a 99-year lease, for a rental of \$600,000 yearly, which amount pays bond interest and 11 per cent. on the stock.

INTERNATIONAL & GREAT NORTHERN.—An issue of \$500,000 receivers' certificates has been authorized to pay for 500 box cars and 10 engines recently ordered. It is said that the certificates will rank ahead of the bonded debt.

LAKE SHORE & MICHIGAN SOUTHERN.—It is said that a two year contract has been made with the Buffalo, Rochester & Pittsburgh for trackage rights from Du Bois, Pa., to Clearfield. When the Franklin-Clearfield cut-off is finished, the Lake Shore will be able to haul anthracite coal from the Pennsylvania fields direct to the West, avoiding the long haul to Buffalo. The route will be from Andover, Pa., to River Junction, thence to Brookville, where connection will be made with the Buffalo, Rochester & Pittsburgh, thence by way of the B., R. & P. and the New York Central & Hudson River to Williamsport, Penn., connecting there with the Reading.

See Pittsburgh & Lake Erie.

LOUISVILLE & NASHVILLE.—See Georgia Railroad & Banking Co.

MISSOURI RIVER & NORTHWESTERN.—The receivers say that the value of the property is less than \$400,000, against which there is an indebtedness of \$2,500,000; they say it will take \$125,000 to put the road on a proper operating basis.

MUNICIPAL TRACTION CO., CLEVELAND.—The Schmidt initiative and referendum law ordering an election to vote on confirming the franchise granted to the Municipal Traction Co., has been held constitutional by Judge Chapman in the Common Pleas Court.

PHILADELPHIA, BALTIMORE & WASHINGTON.—This company has brought suit to compel Interstate Commerce Commissioners Macfarland, West and Morrow to pay \$1,500,000 which Congress provided should be paid when the new terminal at Washington, D. C., was completed. The commissioners say that grade crossings have not been eliminated as required. The company claims that the commissioners have held up the plans for elimination of these grade crossings.

PITTSBURGH & LAKE ERIE.—The directors have declared a semi-annual dividend of 5 per cent., thus reducing the annual rate to 10 per cent. In 1907, 12 per cent. was paid.

PITTSBURGH, BINGHAMTON & EASTERN.—A judgment for \$173,750 has been given to former President F. A. Sawyer, for breach of contract by the bankers who were to have financed the company. About 22 miles of line have been graded and some six miles of track laid. The line is projected from Binghamton, N. Y., to Clearfield, Pa., 225 miles.

RIO GRANDE WESTERN.—See Denver & Rio Grande.

WABASH.—This company, which guarantees the \$8,000,000 Wheeling & Lake Erie three-year 5 per cent. notes, which are due August 1, has proposed to the Wabash-Pittsburgh Terminal first mortgage bondholders' protective committee that the committee take up the Wheeling & Lake Erie notes and thus secure control of the \$12,000,000 new general mortgage 4 per cent. bonds of the Wheeling & Lake Erie, which are security for the three-year notes.

WASHINGTON, ARLINGTON & FALLS CHURCH (ELECTRIC).—This company has passed from receivership into the control of a syndicate headed by R. A. Chester. The company operates a line in and near Washington, D. C. It owns 25 miles of track, including sidings.